# INTEGRATION OF SCIENCE, PRODUCTION AND ENVIRONMENTAL EDUCATION IN TEACHING NUCLEAR PHYSICS

**E.N.Khudayberdiev**
Associate Professor of Navoi State Pedagogical Institute
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***Abstract.*** *This paper analyzes the importance of integration with production and environmental education in teaching nuclear physics in the preparation of future physics teachers in pedagogical universities. On the example of nuclear–physical installations used in the mining industry, a method of dehumidifying the integration of education with production and science is being developed.*

***Keywords:*** *physics, competence, nuclear physics, detectors, mining, ore analysis, spectrometers, radiation, integration, radiometers, production, science environmental education.*

**INTRODUCTION.** Currently, much attention is paid to the teaching of nuclear physics, as nuclear technologies are increasingly being introduced into industrial production, as well as in other areas. This is due to the fact that nuclear technologies have a certain advantage over other methods. Such advantages include the compactness of nuclear installations, high accuracy, reliability of results and other aspects. The curriculum of nuclear physics in pedagogical universities for future teachers includes the topics "Interaction of nuclear studies with matter", "Methods of registration of ionizing radiation", etc.d, which are directly related to production and science. The task of the teacher leading this lesson is the professional implementation of the integration of science, production and education on the basis of an integrated approach. At the same time, an integrated approach should include interdisciplinary and intersectoral integrations, as well as integration between the type of training sessions, such as lectures, laboratory, practical and extracurricular classes. Below we will consider the implementation of this integration using the example of the mining industry and radiological research.

It is known that one of the problems facing the mining industry in the extraction of rare metals and uranium is the difficulty of determining the type and quantity of elements in ore, diverse in composition, and the fact that most elements have the property of radioactivity. These aspects raise the question of the implementation of certain specific technological processes in the process of ore extraction and processing and the related training of qualified personnel performing these works. The composition of samples taken during preliminary geological studies is subjected to express analysis using X-ray fluorescence devices based on nuclear technologies. Based on the results of this analysis, a decision will be made to conduct large-scale excavations in the study area. The need for integration with nuclear physics in the mining industry does not end there. The processes of extracting the necessary elements from the composition of the extracted ore, their processing and use for various purposes are also carried out on the basis of nuclear physical methods.

**RESEARCH METHODOLOGY.** The radioactivity of ores is due to the fact that the elements contained in them are involved in a large number of nuclear processes. Determination of the composition of ores and the number of elements included in this composition is often based on

the study of the spectra of radioactive radiation. When studying the topic "Devices for recording ionizing radiation", it is necessary to familiarize students with the device and the principle of operation of detectors used in research laboratories of the mining industry. Figures 1-2 provide general information about samples of nuclear physics instruments and devices used in scientific laboratories of the mining industry to determine the composition of ores, liquids and control over radiophysical and radiation safety.

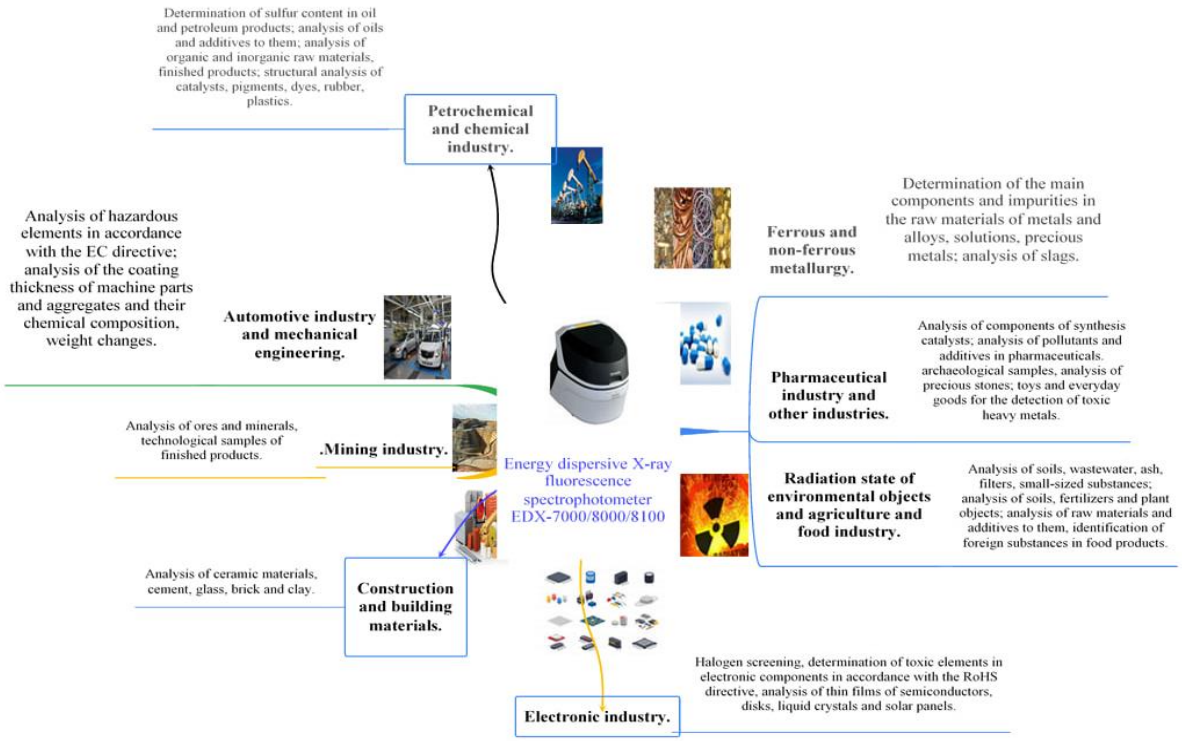


Fig 1. Energy dispersive X-ray fluorescence spectrophotometer EDX-7000/8000/8100

This circumstance necessitates the formation of in-depth knowledge of atomic and nuclear physics and nuclear spectroscopy among specialists engaged in ore processing. We see this situation in the process of training personnel of the Navoi Mining and Technological University in the direction of “Rare and radioactive metals”. Unfortunately, in this case, the knowledge of students studying in this field in atomic and nuclear physics is limited to brief information provided by the program of the general physics course. In our opinion, specialists in this field should study at least a course of nuclear spectroscopy in atomic and nuclear physics, including topics such as the structure and models of nuclei, the binding energy of nuclei, radioactivity and its types, nuclear reactions and its types. In addition, special courses should be taught in radiochemistry, radiation physics and other related areas necessary for the separation of isotopes of various elements, technology of ore dressing processes. The role of pedagogical universities in this aspect is to train competent physics teachers who will work in general education schools in the future. Graduates of secondary schools are the future cadres of all industries. In other words, secondary schools and the knowledge obtained in schools are the basis for training specialists for all branches of production and for science.

The second aspect of the integration of education and production is that currently graduates of pedagogical higher educational institutions work not only in the field of education, but also in many research institutes. Therefore, it is important to increase the competence of graduates of higher pedagogical educational institutions. The implementation of the integration of the process

of teaching atomic and nuclear physics with science and production will contribute to the achievement of the intended goal by increasing the effectiveness of training. From this point of view, future physics teachers should have sufficient information about the direct application of nuclear physics technologies in production.

**ANALYSIS AND RESULTS.** The most effective way to implement the integration of education and production is the organization of scientific laboratories related to production in higher educational institutions. In this regard, it would be advisable to organize a “Center for scientific Research on Physical Radioecology” at the Faculty of Physics of the Pedagogical Institute, equipped with the above-mentioned devices. The creation of such a center will contribute to the further consolidation of theoretical knowledge by students and masters in practice, their wide involvement in research work, the creation of a scientific and laboratory base for experimental measurement work and independent research by doctoral students, increasing the scientific potential of the institute and the effective implementation of commercialization work based on state grants, scientific and innovative projects and business contracts. The expected results from the creation of such centers are:

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- Based on the above, it will be possible in the coming years to increase the rating of the institute at a high rate and enter the top ten.

- Integration of science, education and production is ensured.

**CONCLUSION/RECOMMENDATIONS.** The creation of such research centers helps not only to increase the competence of future physics teachers in accordance with the requirements of the time, but also to solve many related tasks. The competence of teachers determines the most important task in education – the quality of education.

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