

**Russian-IAEA Education Training Centre at Moscow SIA «Radon»: 8 Years Experience  
in Educating Personnel to Manage Radioactive Wastes**

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**ABSTRACT**

The experience gained during last 8 years of educational and training activities of the IETC under the IAEA guidance was described in this paper. For that period more than 160 specialists from 26 European and Asian countries enhanced their skills. The education-training programmes were developed accounting both for the IAEA recommendations and gained experience and attendees' requests. Efficiency of education was carefully analysed using the structural adaptation of educational process as well as factors, which have influence on education quality. Social-psychological aspects were also taken into account in assessing the overall efficiency. The analysis of the effect of individual factors and the efficiency of education activity were carried out based on attestation results and questioning attendees of training courses. A number of analytical methods were utilised such as Ishikawa's diagram method and Pareto's principle for improving of training programmes and activities.

**INTRODUCTION**

International Atomic Energy Agency (IAEA) pays a special attention to training activities which aim to ensure a high quality of personnel involved in management of radioactive waste. Training in this area is a paramount issue of many national bodies. For example extensive education and training activities carries out in Russia the International Education Training Centre (IETC) at Moscow State Unitary Enterprise Scientific and Industrial Association “Radon” (SIA “Radon”) [1]. In the United Kingdom a Nuclear Technology Education Consortium (NTEC) was recently established to meet the UK's projected nuclear skills requirements in decommissioning and clean-up, reactor technology, fusion and nuclear medicine [2]. The NTEC provides a number of core modules among which processing and storage of nuclear waste delivered by the Immobilisation Science Laboratory (ISL) is directly intended to deal with nuclear waste

management problem [3]. Analysis of most important educational issues can be useful in improving the efficiency of education and training processes.

All activities with sources of radiation including management of radioactive waste should be carried out in compliance with internationally accepted safety standards. The necessity to conform contemporary regulatory requirements presumes quality assurance of all processing technologies and continuous quality control of those. Quality assurance system is the major precondition of a successful and competitive activity that is based on professionally educated specialists. The quality assurance programme is of particular importance in managing materials that are potentially hazardous for humans and environment where this system is also directed to avoid misuses and lack of care.

### **ASPECTS OF TRAINING AT SIA “RADON”**

The education system for specialists dealing with radioactive waste was established in Russia (former USSR) in 1983 and was based on two organisations: the Moscow SIA «Radon» and Lomonosov’s Moscow State University, Chemical Department. These courses are held every year. A main quota on courses are the specialists of the regional centralised radioactive waste facilities “Radon”, the new personal of Moscow SIA “Radon” and specialists from other organizations whose work is connected to radioactive materials.

Beginning 1997 this system was upgraded to an international level and acts as dedicated centre, the IETC, under the guidance of the IAEA [4, 5]. The main objective is to demonstrate and introduce to Member States the radioactive waste management methods and procedures which are documented in IAEA technical reports and which are in agreement with international accepted standards and criteria. This demonstration supplements theoretical and practical experience by providing the opportunity to work with real radioactive wastes in real conditions. The IETC in its educational activities involves a number of highly qualified specialists working in the area of radioactive materials [6]. IAEA training activities at IETC are shown in Fig.1.



Fig.1. IAEA training activities at IETC of SIA “Radon”: a) lecture, b) seminar, c) practical exercise

Also the IETC duties are organization of scientific visits, workshops, fellowships and technical meetings for the exchange of information in current technological developments on radioactive waste management on general and individual programmer.

One of the main tasks of IETC is preparation of technical manuals and guidance documents on predisposal management (collection, transportation, sorting, decontamination, pre-treatment and treatment, immobilization, packaging, interim and long-term storage) of sealed radioactive sources and low and intermediate level radioactive waste from various applications of radionuclides and from the nuclear fuel cycle, including nuclear power plants and research institutes.

More than 160 specialists from 26 European and Asian countries enhanced their skills during last 8 years of IETC-IAEA activities.

## **TRAINING TECHNOLOGY**

Training technologies are developed in order to make educational activities efficient and to a little extent be dependent on persons involved. Technology is presented by deliberate and formal steps or procedures obligatory to implementation resulting in receiving desired results.

From pedagogic history it is known that the main education procedures were developed a long time ago. Current new economic and social conditions are erecting a new scale of priorities [7]. The main purpose of educational process is to introduce to personnel a clear idea about major triad: safety-technology-education.

### **Systematic Approach to Training (SAT)**

The modern conceptual principle of a systematic approach is also a technology that is used in practical activities. There are five interrelated phases in the SAT:

- Analysis of training needs,
- Design of training program,
- Development of training materials,
- Implementation of training and
- Evaluation of training efficiency.

SAT is described in many IAEA manuals, for example, "Guidebook on Training to Establish and Maintain the Qualification and Competence of Nuclear Power Plant Operations Personnel. *TECDOC 525*" [8], "Nuclear Power Plant Personnel Training and its Evaluation, a guidebook, *TRS 380*" [9].

### **Training program and Curriculum**

Generally the program of improving personnel qualification should comprise following functions:

- providing with lecturers and instructors;
- training and stimulation;
- increasing of personnel information;
- strengthening of social orientation trough study of enterprise structure, business connections.

Training Programme and Curriculum are different in concept. The programme is a summary of training, range of knowledge, skills that personnel have to learn. Curriculum determines subjects,

their order, time table and attestation. An example of one-week IAEA Workshop programme is shown in the Table I.

Table I. Programme of One-week Workshop on Searching, Identifying and Recovering Radioactive Sources

Lecture	Practice	Demonstration
<ul style="list-style-type: none"> <li>• IAEA activities in safety and security of sources</li> <li>• International undertaking of the “Orphan sources” management problem (Action plans, Preventing loss of control, National strategies)</li> <li>• Applications and Lost of Control of Radioactive Sources</li> <li>• Categorization of Radioactive Sources</li> <li>• Methods to Search, Identify and Locate Not Controlled Radioactive Sources</li> <li>• The experience of radiation-accident works with Orphan sources» System of control and registration of spent sealed sources.</li> <li>• Estimation of location radioactive anomaly possibility</li> </ul>	<ul style="list-style-type: none"> <li>• Radiation control devices and means of radiation monitoring</li> <li>• Identification and sorting of spent sealed sources.</li> <li>• Search and location of «Orphan source».</li> <li>• Action from place and emplacing in transport pack</li> </ul>	<ul style="list-style-type: none"> <li>• Unloading of transport container with high activity spent sealed sources</li> <li>• Perspective technology of RW treatment and scientific developments</li> </ul>

### Training form and means

The main training forms are the traditional ones: lectures, seminars, practical classes, computer simulators. Technical means as different diagram, scheme, audio- and video, books, training manuals, instructions are used to education at the Centre.

### Training control

Both oral exam and computer testing are used to control the assimilation of programme in the IETC.

## SOCIAL-PSYCHOLOGICAL ISSUES OF EDUCATION

Social-psychological aspects were also taken into account in assessing the overall efficiency.

Table II gives education quality indexes based on 5 marks system. These were obtained from questioning 70 of attendees of one-week IAEA training courses on managing spent sealed radioactive sources in 2003-04. The training may be based on the carefully balanced programme and performed according to detailed schedule. The feature of additional education institutions is that they are open-ended structures. Qualification of teachers, instructors and training centre personnel has a great influence on learning efficiency but not solely these. The methodological and organizational factors, interaction with the partners and administration of the enterprise are very important too. Among these and other factors, social and psychological aspect of training is an object of consideration. Assimilation of educational material depends on such factors as training motivation, background education, age, experience of work and social status, and the degree homogeneity of the trainees group. This degree is in various parameters, for example, in the purposes of training. The specificity of IETC and the others similar organisations is that we can work on maintenance of quality of the educational programmes, methodical material, organization of training, but we can not form groups of trainees.

The heterogeneity of trainees groups influences on estimations disorder. This is particularly true in regarding the contents of a specific seminar (see Table II). We also notice such disorder at realization of the well-developed training program.

The analysis shows that practically in all aspects the attendees are satisfied with the content of programmes and their novelty as well usefulness of seminars. Note the scatter of marks, the range of their change data from “useful” to “very useful”. Analysis showed that the main factor acting on the marking is the homogeneity of group. This factor acts even when the programme is at a highest level of request and novelty involving very qualified instructors.

Table II. Education Quality Indexes Based on End-of-Course Questioning

№ seminar	Technical content		Form and means of education		Efficiency of course		Conformity to expectations		Social psychological aspects	
	Medium mark	Range	Medium mark	Range	Medium mark	Range	Medium mark	Range	Medium mark	Range
1	4,7	4 - 5	4,6	4 - 5	4,3	4 - 5	4,2	3 - 5	4,7	4 - 5
2	4,6	4 - 5	4,7	4 - 5	4,0	3 - 5	4,1	3 - 5	4,6	3 - 5
3	4,8	4 - 5	4,7	4 - 5	4,0	3 - 5	3,8	3 - 4	4,7	3 - 5
4	3,9	3 - 4	3,9	3 - 4	3,1	3 - 4	3,2	2 - 4	3,9	3 - 5
5	4,1	2 - 5	4,0	3 - 5	3,9	3 - 5	3,9	3 - 5	3,9	2 - 5
6	4,6	4 - 5	4,1	2 - 5	4,3	3 - 5	4,3	3 - 5	4,2	2 - 5

Comments: Session contents, Forms and means of training, Social and psychological aspect:

5 – excellent, 4 – good, 3 – satisfactorily, 2 – insufficiently.

Efficiency of course: 5 – all is useful, 4 – much enough, 3 – something, 2 – nothing is useful.

Conformity to expectations 5 – full, 4 – enough, 3 – limited accordance, 2 – no accordance.

Social and psychological aspect includes quality estimations regarding the organization of training, residence, cultural programs, social events, etc.

The educational organisations that provide supplementary professional education such as IETC are not independent (closed) structures. Therefore the efficiency of education depends not alone on qualification of instructors and methodological factors but also on the interaction with partners and administration. Social psychological aspects are also important at the last but not the least. Perception of educational material depends on motivation to education, background knowledge, age and working experience, social status (work status) and on the degree of homogeneity of group at different parameters such as educational targets. Non-homogeneous groups are characterised by a scattered distribution of marks, particularly for those of technical content at seminars.

A provisional team is formed during IETC training activity. Complex social connections between members of this team are shown in Fig. 2.

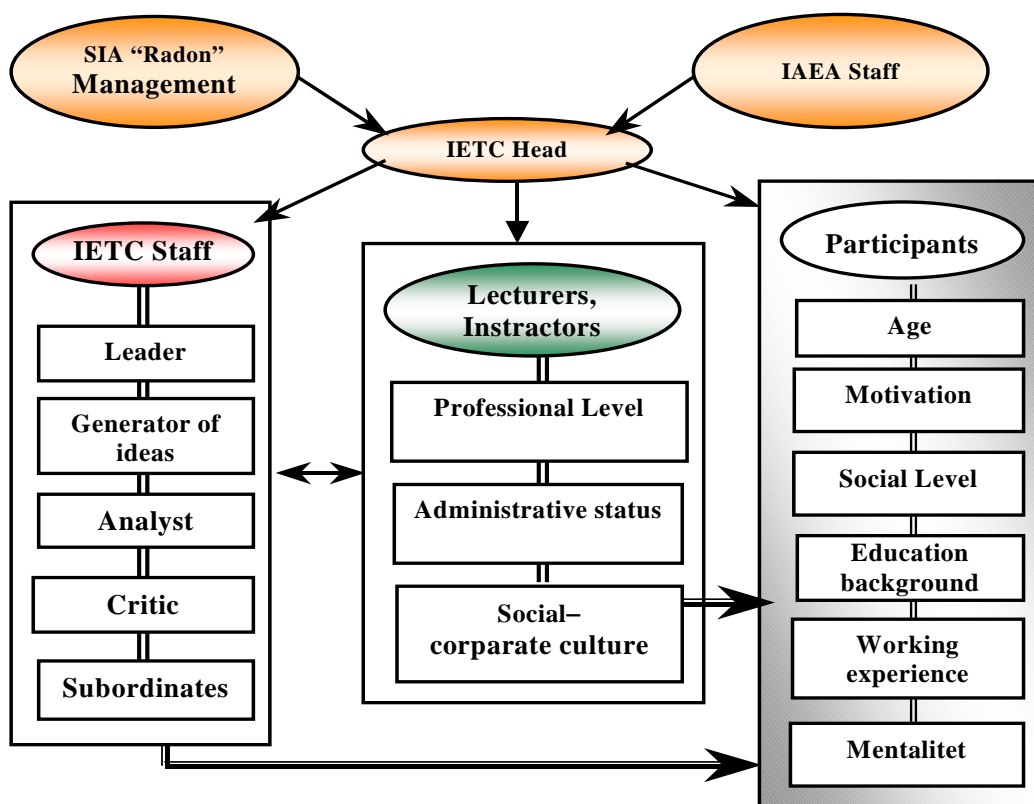


Fig. 2. Social connections between members of provisional team

Mental approaches can be accounted in the analysis of questionnaires, because the analysis of results of final survey indicates its influence on a level of training quality estimations. It proves to be true by correlation of estimation change of all aspects of training from seminar to seminar, i.e. we have noticed a concurrence in minima and maxima in all interdependencies. Fig. 3 demonstrates this coincidence of maximums and minimums.

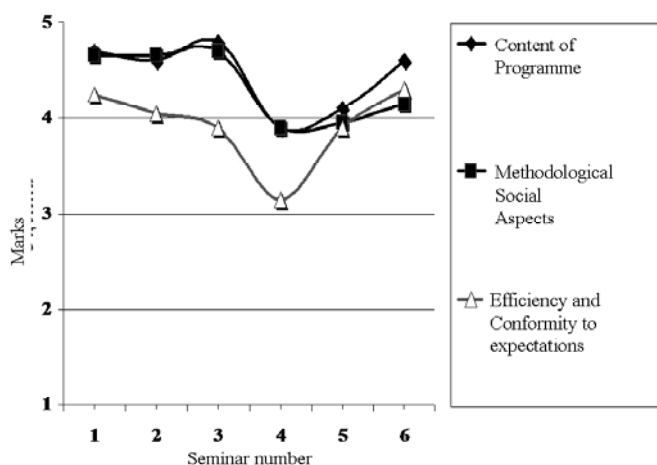


Fig. 3. Dependence of education quality indexes at IETC-IAEA seminars in 2003-04

## STUDY AND ANALYSIS OF TRAINING QUALITY

The education-training programmes were developed accounting both for the IAEA recommendations, IETC gained experience and attendees' requests. Efficiency of education was carefully analyzed using the structural adaptation of educational process as well as factors, which have influence on education quality.

The analysis of the effect of individual factors and the efficiency of education activity were carried out based on attestation results and questioning attendees of training courses. A number of analytical methods were utilised such as Ishikawa's diagram method and Pareto's approaches including Pareto's principle [10 -12].

Fig. 4 shows a simple Ishikawa diagram. Note that this tool is often termed by several different names: Ishikawa diagram, Cause-and-Effect diagram, Fishbone diagram. The purpose of action considered in the diagram is to analyse a few key sources that contribute most significantly to the problem being examined. These sources are then targeted for improvement. The diagram also illustrates the relationships among the wide variety of possible contributors to the effect. The basic concept in the Cause-and-Effect diagram is that the name of a basic problem of interest is entered at the right of the diagram at the end of the main "bone". The main possible causes of the problem (the effect) are drawn as bones off of the main backbone. When the fishbone is complete, it has a rather complete picture of all the possibilities about what could be the root cause for the designated problem. The Ishikawa diagram, like most quality tools, is a visualization and knowledge organization tool. Simply collecting the ideas of a group in a systematic way we facilitate the understanding and ultimate diagnosis of the problem.

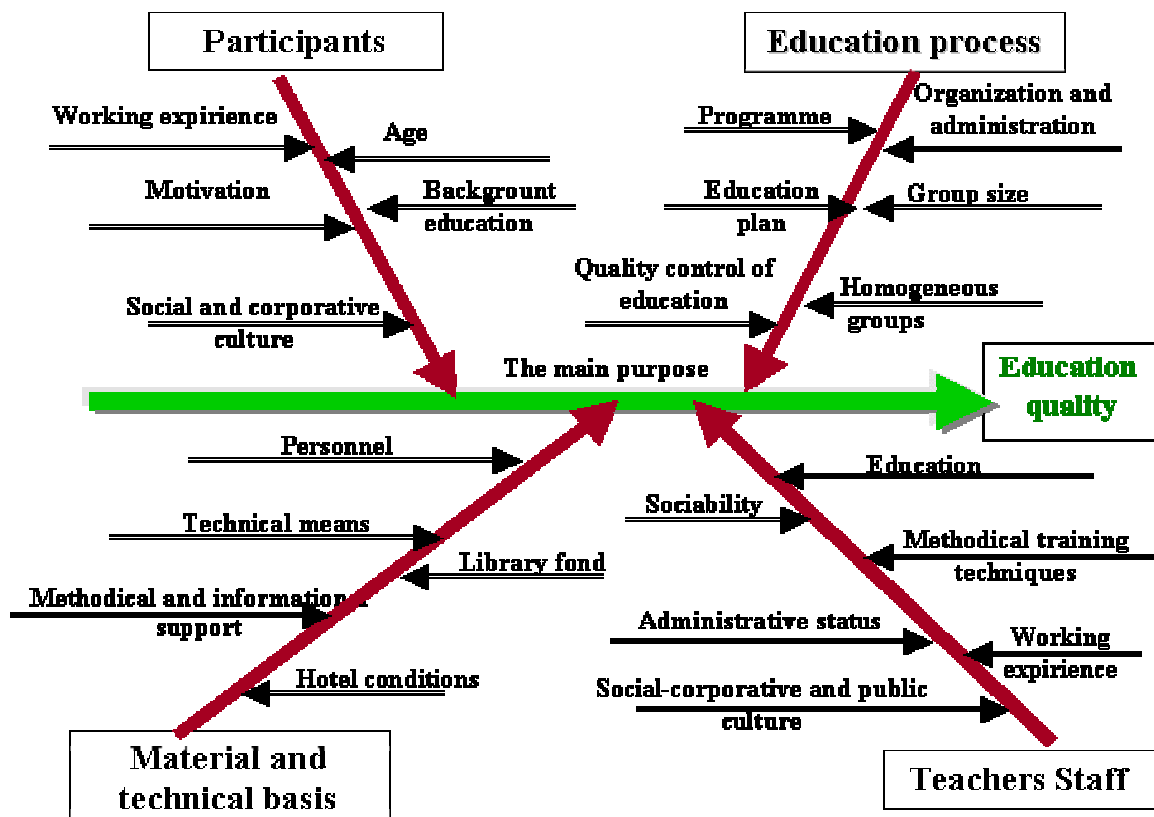


Fig. 4. Ishikawa diagram of education and training processes

Currently there is a reopened attention on Pareto's approaches in socio-economical activities [12]. The principle, that 20 percent of activities are in practice responsible for 80 percent of the results, is known as Pareto's Principle or the 80/20 Rule. The value of the Pareto Principle for the education manager is that it reminds to focus on the 20 percent of most important, key activities, which provide the success. Among activities that we do during education and training in practice about 20 percent really provide the overall success. Because these 20 percent of activities produce about 80 percent of our results it is necessary to identify and focus our attention on them.

## CONCLUSION

Analytical approaches such as Ishikawa's diagram method and Pareto's principle are simple and useful tools to improve the efficiency of education and training processes. Analysis of social-psychological aspects plays an important role for the successful performance of educational systems. Training of personnel has its peculiarities in the area of radioactive waste management moreover its problems need an open discussion. The experience gained in this area is useful for various educational organisations.

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