The global determinants of mining higher education development

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Abstract
The entry of Ukrainian, Russian and select Commonwealth of Independent States (CIS) countries' to innovative development should reflect world trends of international cooperation among higher education institutions dealing with engineering staff training and integration of higher technical education. Aligning with set standards in technical, production and administrative processes in the mining industry in different countries allows for international integration of mining engineers' higher education training, especially in countries that actually produce raw materials. The response to the challenges put by globalization of higher education, and a compelling need of the international expansion of higher schools, should be innovative, interactive and apply language determinants to the process. The given determinants should be implemented at the level of a definite higher education establishment by using innovative pedagogical technologies, such as binary lectures, role plays, brainstorming, case study or project training in educational processes.
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Prospects in modern industry development are defined as a transition to the post-industrial stage of public production development [1]. It is characterized, on the one hand, by a high proportion of processing deep raw materials, mass production of intellectual products and, on the other hand, by the development of a "knowledge economy", the outcome being technical higher schools leading in innovative development [2-4]. The advantages necessary for innovative development in a number of former Union of Soviet Socialist Republics (USSR) countries are extensively discussed in the scientific community. They are: a relatively high level of urbanization, significant scientific and industrial heritage, growing natural resource sector economy, a relatively modern system of engineers training [5-7].

Currently, we observe the trend of integration of industry and higher education subjects in engineering, globalization of national educational systems and development of international university cooperation. These all play a part in the globalization process of production and education. This formation of the global education system fully aligns with the Bologna agreements.

When applying conceptual issues set by Bologna for modern higher education to mining engineers training tasks [8, 9], we can define the following:

- Do not extend study periods at higher schools, reducing the financial costs to governments of students while maintaining the quality of training. This plays a special role in mining higher education, the quality of which determines the competitiveness of the national raw material complex, and also labor safety.

- To guarantee skill levels of graduates which allow entry into the production process and the management of complex technological processes in modern mining enterprises immediately.

- To integrate national systems of mining engineers' training in the world labor market in order to train modern staff in oil and gas, coal, mining industries, ferrous and nonferrous metallurgy, energy engineering as well as oil and coal chemistry.

- To provide an opportunity for the mobility of graduates with the purpose of advanced professional training and employment opportunities in any country, including the European Union, through a system of grants for students from other countries.

- To ensure the compatibility and comparability of national systems of higher engineering education and to establish uniform educational standards.

But the main requirements for modern higher education are set by the international community of raw material producers, in which barriers to the international movement of goods and investment are being broken down and international migration of experts is accelerating every year.

Many graduates from modern technical universities, attending training, for example, in Germany, France, Britain and China, find themselves in a cross-cultural and educational multi-platform community in which such things as modern and traditional methods of knowledge transfer, a variety of educational legal frameworks and standards of corporate ethics and social responsibility coexist.

Today most universities in Ukraine and Russia, including technical ones, are just beginning integration into the global education community. The major obstacle of this integration process, however, is the low position of these universities in international rankings. No Russian university, for example, is rated in

the internationally recognized «Top 200 world universities rankings Times higher education-QS» in 2012-2013., in which the top ranks went to universities in the United States and the United Kingdom. This list includes, for example, universities in China, Singapore, Australia, Belgium, South Korea and others. [10].

Another difficulty for integration of engineering education in the former Soviet Union countries has become: limited acknowledgement of national universities' diplomas for employment abroad. Graduates often have to prove their knowledge and skills through additional testing. The number of training specialists in higher education, including mining engineers in Russia, is gradually declining. One reason is the apparent lack of motivation and readiness of students to train at higher schools. In fact, higher mining education in the former Soviet Union will have to overcome the disunity of interests of universities - suppliers of educational services and businesses - educational customers and the state - the owner of institutes and universities, and to go through several levels of educational sphere globalization.

Today's engineering higher schools engaged in training staff for the mining industry face two fundamentally new challenges of international integration.

Firstly, the globalization of the educational sphere as a response to the globalization of the economy makes higher education in mining unitary, forming similar requirements for engineers training in diffe- rent countries. This is facilitated by the use of similar techniques and technologies, management and organization of production in the mining enterprises of Ukraine, Russia, Eastern and Western Europe, North and South America, Africa, Australia, China and others. This gives universities of different countries new impetus for the integration of scientific and educational activities, implementing joint projects to improve the quality of higher mining education.

Secondly, on the path to integration with the global educational system, of technical higher schools in the former Soviet Union involved in the training of mining engineers, there are some problems that reduce their competitiveness on the global educational market. These problems are associated with the long-term isolation of the USSR higher education system from international standards, the decay of university science in the reform period (1990s), the marginalization of pedagogical work and the loss of its social prestige as well as a lack of innovation in mining techniques and products. As a result many technical higher schools are trying to survive in the education market by focusing on specializations in economics, administration and law, but less so in mining. Resources left to mining in human, financial and material resources, in order to become leaders of innovative processes in the industry, are lacking.

In addition, in former Soviet Union countries the possibilities of integration into the global educational space during training processes of mining engineers are not fully realized. We refer to them: acquaintance with the latest technological innovations in the industry, professional language training and international student exchange with the leading centers of mining education; in the United States, France, Germany, and China.

It is necessary to provide conditions encouraging the integration of higher engineering schools in the international environment of higher mining education. These major conditions - the determinants of the international process - belong not only to the external environment (signing Bologna agreements, international student exchange and training of foreign students). The starting point should become the application of international requirements to the educational process itself at higher schools. Determinants of the integration of universities into the international system of mining higher education, connected with the educational process, must apply innovation, interactive forms of organization/administration, as well as the development of language skills up to the level that allow graduates to compete in the global labor market.

An innovative determinant includes constant creative searches carried out by university teachers, the introduction of advanced models of equipment and technologies and the diffusion of new knowledge in the pedagogical community. In fact, we are talking about the formation of a powerful module of teaching innovations in the mining educational system [11]. An important role in this process should be played by innovation in training, in particular, the transition to new forms of lecturing - problem and binary lectures.

At the present stage of mining science development traditional lectures are less effective in delivering new information, introductions to new techniques and technologies in the professional mining community, patenting of inventions and diffusion of innovations in production. Therefore, the traditional form of lectures - monotonous presentation of information by the teacher - should give way to lectures involving students in collective interaction with the teacher and with each other, in discussion of problems and prospects of introducing innovations in mining production processes.

For example, during a problem lecture the teachers

and students are in active scientific and cognitive positions, provided the lecture is a live dialogue. The subject of this dialogue can be the discussion of the effect of innovations, replacing obsolescent equipment and the use of new progressive forms of production.

So, for students studying in the Mining specialization "Open pit mining" at technical higher school the issues for a problem discussion during the lecture may be potential tasks for increasing environmental protection of mining production and purification of polluted water bodies or rock destruction problems [12-17], the growth of equipment productivity and increasing the product quality.

An instructor, asking questions and finding answers together with students, involves the audience in the discussion. Answering students develop engineering thinking, show responsibility and defend their notions. The instructor plays the main organizing role during the problem lecture dialogue because his ability to lead the discussion and interact with students influences greatly on their active study of innovation of processes in industry.

Another example of training technology, following the principle of problem and dialogue communication, is a binary lecture. This technology implies simultaneous collaborative work of two teachers lecturing on the same topic and interacting on the problem introducing organized material to the audience. Teachers set up problems and then show the students an example of analyzing, hypothesizing, proving or disapproving, conflicts resolution and searching for solutions to those problems.

Today it is very important for mining engineers training to attract experts – managers of coal mines and open pits, coal-preparation plants and power engineers – to educational activities. They are the ones who are able to deliver innovations in the mining industry, conceive problems and prospects for innovation in actual companies to students and to share their views and experience. Mining engineers, however, usually have no experience in teaching and lecturing, so they are reluctant to participate in the educational process at universities.

We consider that it is necessary to take into account the experience of some international technical higher schools (such as Imperial College London) which establish a special position of "Resident Mining Engineer" at their chairs. It can be someone who works in the industry (anyone in management at any mining company) and helps higher school teachers in lecturing and providing technical problems.

That is why binary lectures conducted by the university lecturers, in alliance with engineers, employees or executives of a mining enterprise, are the most appropriate way to make the educational process innovative. Binary lectures for mining engineers include the following steps:

- selection of appropriate topic in the content of which both traditional and innovative issues of mining or different points of view are provided;
- selection of two teachers, compatible in thinking style as well as the way of communication;
- development of a lecture scenario (plan, main thesis, timing and so on).

There are no doubts that lecture, as a form of teaching, plays an important role in university training of mining engineers. At the same time the importance of practical studies, which presents an opportunity for students to test and apply their understanding of the concepts and ideas introduced in lectures, should be noted. Practical studies are often carried out traditionally – in the form of calculations, drawings and solving technical problems.

An interactive determinant of the integration process in the university training of mining engineers, therefore, includes the use of specific training technologies aimed at improving the efficiency of forming professional competencies of students, and stimulating their interest in innovations. These technologies include: role-plays, brainstorming and case studies.

Role-play is a form of interactive teaching that is primarily focused on obtaining a particular result of the problem discussion by means of interaction between its participants. This result may take the form of project development for the introduction of new equipment, the development of new mining operation plans, the introduction of a new appraisal system for employees and the introduction of improving safety measures, among others.

Therefore the main characteristics of the role play are: an opportunity for students to approach, closely, real problems in production management, exposure to working toward common goals in large groups and collective decision-making activities.

No less important to interactive teaching used for engineering staff training at the university is brainstorming. It allows finding a significant number of solutions to professional problems for a short period of time, and approaching their evaluation critically. All ideas, however intuitive or original, are accepted and listed for further discussion. After detailed analysis of the ideas put forward by the participants there should be one which is the best in any given situation.

Open pit mining experts may, through brainstorming,

solve: emergency response, increasing labor productivity, the selection of new equipment of domestic and foreign producers and improving product quality, among others.

In the scientific literature we can observe the following mechanism of the brainstorming procedure: setting the problem to be discussed; selection of the leader of the brainstorming session; selection of two secretaries, fixing the proposed ideas; holding a brainstorming session; analysis of results and selection of the final problem solution. The brainstorming session involves three stages: induction (training) stage (5-10 min.), working session stage (10-20 min.), final stage - the selection and discussion of the final decision (10-15 min.).

Case study technology (i.e. the study of particular situations likely to occur in actual operations) is based on a group-discussion of problems having taken place in mining companies, and the ways of solving them. It is desirable to attract practicing mining engineers in leading industries to provide these problems in order to show the students the importance of making rational and reasonable engineering decisions as well as to instill a sense of accountability.

Each problem (case) should include the following: a detailed description of the source of the problem and comments connected with it, as well as the roles that certain managers and engineering staff play in it. In the context of mining enterprises problem situations can be connected with relationships in a team, adapting employees to new positions and responsibilities, the introduction of innovations, installing and integrating new software, as well as the problems arising during the operation of machinery and undergoing mining operations [18].

The main advantages of using a case-study in the process of higher mining engineering training are:

1. The possibility of students' immersion in challenging situations reflecting common problems in the industry, which will be typical for future professional activity.

2. Increasing the effectiveness of training with more intensive digestion of educational information through visually intensive delivery of topics.

3. Emotional involvement of students in the learning process, increasing motivation to study the subject, along with its obvious practical advantages.

4. Deep practical skills and professional competencies training in classroom activities when using case study technology.

Along with those mentioned (above), the most important factor of international integration of national higher mining education is the mobility of students and teachers of technical higher schools. This increases the importance of the linguistic determinant of the integration process - complexity of skills, which enables engineers to solve problems of personal and professional communication in a foreign language. Implementation of the linguistic determinant allows students to deal with innovative technologies, to know about the latest equipment and the prospects of its usage and to obtain information about the improvement of mining machinery in addition to manufacturing processes. A significant element of the linguistic determinant is lexical and grammatical knowledge necessary to obtain information from foreign sources [19].

The international transfer of new technologies, worldwide usage of equipment produced by leading world manufacturers, the outcome of technical higher schools in the global labor market - all these lead to the necessity of training mining engineers with high levels of foreign language skills [20]. Despite the indisputable importance of language skills, however, we are witnessing the reduction of in-class learning of foreign language in Russian higher education institutions involved in the training of mining engineers.

This sets the problem of the realization of the interactive determinant (the use of role plays, brainstorming, and case study) during practical studies while teaching disciplines in a foreign language. Due to the reduction of in-class learning, this process moves toward independent and extracurricular work, one form of which is the project method.

The project method involves students' extracurricular work directed to collecting technical information connected with professional issues focused by the instructor in a foreign language, and its analysis. The result of this work should become the project development of mining enterprises and its allotment, as well as the presentation of this project. The importance of these projects made in a foreign language is determined, on the one hand, by the necessity of using scientific and production potential accumulated during the development of mining abroad [21]. On the other hand, it is "project" thinking which allows university graduates to find employment and progress in their career at international industrial companies.

In summary, it should be mentioned that the tasks that the Bologna agreement set for universities involved in mining engineers' training in former USSR countries are directly connected with the integration of the national system of higher technical education globally. The successful solution of these problems is constrained by such problems as the weakening of university science during reform periods, long-term

isolation from the world educational standards and under-funding of universities. An important driver of international integration of mining engineers' training, therefore, is international requirements - innovative, interactive and linguistic determinants. Their implementation requires the development of teaching technologies at higher schools in particular, and emphasis on language competence, involving real engineers in the educational process.

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