

Innovative Technics of Managing Engineers' Global Competencies

This content has been downloaded from IOPscience. Please scroll down to see the full text.

2016 IOP Conf. Ser.: Mater. Sci. Eng. 142 012122

(<http://iopscience.iop.org/1757-899X/142/1/012122>)

View [the table of contents for this issue](#), or go to the [journal homepage](#) for more

Download details:

IP Address: 193.233.152.253

This content was downloaded on 05/09/2016 at 08:24

Please note that [terms and conditions apply](#).

You may also be interested in:

[Metallic nanowires on SmSi interface](#)

E Duverger, F Palmino and J C Labrune

[Observation of Ferroelectric Domains with a Scanning Electron Microscope by Decoration Technics](#)

Didier Beudon, El Harbi Boudjema and Raymond Le Bihan

[A simple holographic technic for fabricating LC/ polymer switchable Fresnel lens](#)

H. Nemati, E. Mohajerani, A. Moheghi et al.

[Development of Goss texture during grain growth in Fe-3% Si](#)

G Abbruzzese and S Fortunati

[The effects of quantum field renormalization on the predictions of inflation for the CMB anisotropies](#)

I Agullo

[Design of energy generation system by using spinning bikes](#)

J Flórez, C Núñez, G Osma et al.

[An easy physics outreach and teaching tool for holography](#)

T Voslion and A Escarguel

Innovative Technics of Managing Engineers' Global Competencies

A A Khoreshok¹, S A Zhironkin², M A Tyulenev³, G A Barysheva⁴, V Yu Blumenstein⁵, M C Hellmer⁶, S V Potyagailov⁷

¹Dr.Sc. Professor of Mining Equipment department, National Research Tomsk Polytechnic University. Russia, 634050, Lenina av., 30

²Dr.Sc. Professor of Economy department, National Research Tomsk Polytechnic University. Russia, 634050, Lenina av., 30

³PhD. Assistant professor of Open pit mining department, Kuzbass State Technical University, Russia, 650000, Kemerovo, Vesennaya st., 28

⁴Dr.Sc. Chairman of Economy department, National Research Tomsk Polytechnic University. Russia, 634050, Lenina av., 30

⁵T.F. Gorbachev Kuzbass State Technical University, 28 Vesennaya str., Kemerovo, 650000, Russia

⁶MSc in Hydrology and Water Resources Management., Department of Civil and Environmental Engineering, Imperial College London. United Kingdom, South Kensington Campus, London SW7 2AZ, UK

⁷Post-graduate student, National Research Tomsk Polytechnic University, National Research Tomsk Polytechnic University. Russia, 634050, Lenina av., 30

E-mail: ³tma.geolog@kuzstu.ru

Abstract. Higher education modernization in the CIS countries takes place under the conditions of dynamic changes in economy and society. These changes are determined by the social and economic development of the country and the world globalization processes - cross-border intercultural communication, knowledge transparency, and the establishment of information society. Educational globalization is a continuous process of creating a unified global educational system, in which the distinctions between its member educational systems are being blended.

1. Introduction

Globalization of education is not possible without the development of regional and interregional cooperation in the field of educational, information and communication technologies, establishment of virtual universities, equality and access to education [1]. Globalization of education reflects the strengthening of the links between international business and nations, by means of multinational corporations to become the main customer of educational services, the development of the Internet, the growth of cities, and the standardization of industrial products reporting system [2]. In the process of creating a unified cross-cultural business environment the value of foreign language, mostly English, increases



many times as it becomes a means of transmission of the global economic, social and cultural information.

Thanks to the universality and integrity - the basic principles of educational globalization - modern specialist, who speaks professional foreign language, attains global competitiveness in the labor market. This was an important element of Bologna Process, which Russia joined in 2003 [3].

Today the engineering universities of the former Soviet Union countries go through the following set of integration processes:

1. At the educational and methodical level of a particular university implementation of international experience of practical engineering activities in the educational process is expanding. It is realized in the course of the project and case-study training, interaction of teachers and students.

2. At the university level, the degree course scheme and curriculum are being adapted to the needs of specific businesses - educational customers; target training of the engineering staff is being developed. International manufacturers' entering Russian markets makes higher educational institutions world requirements for quality of engineers' training, encourages universities to cooperate with scientific organizations, initiates the development of original copyright courses, gives impetus to the development of in-house training directly in the workplace.

3. At the regional level the conditions for the development of inter-university, scientific-and-educational cooperation are being created. At the same time, increased competition in the domestic and international markets of educational services raises the question of improving the competitiveness of technical higher schools. Its primary factors are innovative educational activities and the ability of universities to participate in the development of the national innovation system. But it is impossible without having foreign language skills by teachers and students.

4. At the national level the system of universities is being adapted to international standards of quality training of engineers, to the level of graduates' competence, to the technical equipment and teaching materials provision of educational process. It's no doubt that the leading role in this process belongs to the technical universities, which should preserve and increase the scientific and industrial potential of the national economy.

5. At the international level, globalization of the education system has some sort of response to the integration processes in the world economy, the formation of a global information space, international labor migration. For the technical universities of CIS countries educational globalization opens up the possibility to act within the framework of the space-knowledge paradigm of social-and-economic development. This means that higher technical education, due to its applied nature, becomes an important factor of production and brings its owner a guaranteed income regardless the country in which the engineer works.

In this regard as significant directions for further Russian higher education modernization European benchmarks of educational systems consistent with the objectives of internationalization and creation of a common European Higher Education Area became of the first priority. During higher education reforms in the CIS countries, there was a definite rethinking of the previous system of training of professionally significant qualities of future specialists. Today they are called "competencies", which are the ability to apply knowledge, skills and personal qualities to be a successful specialist in a certain professional area [4].

2. Material and Method

The homeland of competence approach can be considered the UK, where this term had been proposed and studied in detail by J. Raven, a professor at the University of Edinburgh [5]. The competence approach to the training at higher school, according to the first researchers, is based on such a system which provides the quality of training consistent with the requirements of modern global labor market. In connection with scientific and technological progress and, as a consequence, the emergence of new professions higher educational systems in a number of countries have turned their attention to the need to align the requirements of the labor market, training and education.

For example, T. Brinker defines competence as the key abilities of the future specialist and gives them global character. As key competencies she considers the following abilities: taking the initiative (orientation to the result, ability to change, ability to make decisions, etc.), attracting partners (the ability to implement, communication skills, customer orientation, etc.), developing strategy for success (learning ability, strategic thinking, etc.), team managing (the ability to motivation, the ability to appreciate the position and resolve conflicts, etc.) [6]. As we can see, the key skills of specialist are unchanged for any kind and place of professional activity and, therefore, they are global.

Former Principal of Cumbria Institute of Arts, D. Vaughan emphasizes the global role of key competencies by defining them as a personal "portable" skills - time management, teamwork, communication, presentational skills, information technology, business skills, independence and autonomy, self-criticism, the ability to present themselves and others [7].

In today's global economy, these competencies can be realized by specialist working in any country. This is especially important for Mining Engineers, because mining industry is the basic one for most countries. And the important global competence, integrating all others, is a professional foreign language skill.

Russian federal state educational standards define the professional and common cultural competences. General professional and specialized skills which characterize a person as a professional are referred to the professional competencies. But in modern conditions it is not enough to train only professional competences in order to meet the demand of the market, so there is a need to form a common cultural competence at students.

General cultural competences include the following: social and personal, organizational, administrative and general scientific skills necessary for specialists to carry out their professional duties and to be successful and in demand in the labor market.

For example, Russian state educational standard for mining engineers training of "Open pit mining" specialty represented 22 common cultural and 28 professional competences, 10 of which we consider global.

To the latter we refer such common cultural competence as "to speak foreign language in order to study foreign experience in professional activities, as well as to contact on professional level." It is tightly connected with other common cultural competences demanded in today's global world:

- to be able logically, convincingly and clearly express thoughts, to speak orally and write properly;
- readiness to cooperate with colleagues, work in a team;
- the ability to negotiate, establish contacts, to resolve conflicts of interest ;
- to strive to self-development, upgrade qualifications and skills;
- the ability to analyze the philosophical, social and personal problems, independently form and defend personal ideological positions;
- readiness for social interaction in various spheres of social life, for cooperation and tolerance.

Future engineer will be able to implement the global competences while working in multinational teams abroad or in multinational corporations. The following professional competences, which have global character, become the condition for successful employment in the world labor market:

- provide technical management of mining activities in the exploration and extraction of minerals, manage the processes at production facilities;
- to develop and bring to the performers of mining operations the tasks; to carry out the control of work quality and to ensure the correct implementation of it by the performers; to prepare work schedules and long-term plans, regulations, estimates, requests for materials and equipment, to fill in the necessary reporting documents;
- to study the scientific and technical information in the field of operational exploration, extraction, processing of solid minerals.

But the "bridge" to the formation of global competence, in our opinion, is the use of innovative training technics in foreign language teaching of future mining engineers. The key to success here is the integrated formation of language, common cultural and professional skills while teaching them foreign languages, and using pedagogical innovations.

Structuring criteria of innovation process in higher education are diverse enough. Thus, based on the spread scale global, national and university innovations are distinguished. Such changes in the educational systems as the use of the Internet, the establishment of virtual universities, online conferences, and webinars are referred to global innovations for CIS countries. The transition to two-stage system of training, the use of the ECTS (European Credit Transfer System), the introduction of rating system of knowledge and students' independent work assessment should be named among educational innovation.

3. Results and Discussion

The use of interactive teaching technics, computer technologies, the creation of student community, the work of the tutors, etc. become integral elements of innovation at the university level. Based on functional criterion, innovations can be divided into *intra-subject* (identified by the peculiarities of particular subject and activity of the teacher), *methodological* (they are connected with the organization and methodical support of the educational process), *administrative* (decisions taken by the managers of different levels in order to improve the efficiency and quality of the educational process) [8].

In the context of the competence approach conscious rethinking of the content, technics and teaching techniques of foreign language at technical higher schools is taking place. Teachers are increasingly applying to innovative technologies and technics such as interactive teaching technics and the use of computer technology. Variability, which consists in an adequate choice of a particular technic aimed at the formation of a certain professional or common cultural competence, performs an essential element in increasing the effectiveness of the educational process. Among the variety of interactive training technologies of foreign languages special attention should be paid to: role-plays, case-study, brainstorming, "653" method, as well as the project technic, which enhances students' independent and extracurricular work.

In the scientific and methodological literature there is a number of studies devoted to theoretical and practical understanding of innovation activity in the development of competence approach to the educational process [9-15]. Therefore, we will omit the theoretical issue, but merely note that, within the higher school training of mining engineers special attention deserves role-plays, brainstorming, case-study and project technic.

"The point of application" of innovative teaching in the formation of global competencies should become foreign language learning by the future mining engineers. We believe role-play to be a means of simulation the professional activity, and its implementation in training provides conditions for the formation of both professional and common cultural competences.

Starting with the first lessons students prepare for the play gathering factual, relevant information relating to the topic for its further using in the scenario. Language (ability to build sentences grammatically and lexically correct in a foreign language) and communication (ability to interact with a partner, choosing the appropriate (verbal and non-verbal) means of communication) skills are being trained in the classroom activity during the entire study period. This process implies the use of special tasks which help students to prepare to spontaneous communication on professional topics.

These tasks include the preparation and presentation of the role dialogue, listening comprehension, etc. After the role-play teacher, together with students conducts its detailed analysis, identifies the achievement of educational and play's goals, comments on the students' progress in language and communicative skills, corrects mistakes and makes recommendations and suggestions for the future. Using role-play in the classroom enhances students' interest to the language learning, removes psychological barrier in foreign language communication and contributes to the formation of common cultural and professional competences.

Recently, such technic as case-study has been widely spread in teaching foreign language at technical higher schools, some researchers and textbooks' authors call it problem solving or dilemma and decision. Analyzed the situation, offered to students must have a definite structure consisting of a number of components. The first component is a problem background or brief history, which describes the main actors of the conflict, their economic and financial situation, relationships with each other, etc.

This is followed by the information detailing with the problem itself and containing a specific task for students.

The tasks may be the following: working in small groups (group), analyze the problem on behalf of the participants, present your solution, prepare the report (presentation), conduct negotiations to resolve the existing conflicts between companies, etc. The final component may be a written task (write it up), which includes the preparation of a report, memo or minute of negotiations, depending on the content of a problem situation.

Using case-study in learning process helps students not only to raise their language level, but also shows them how to build the paradigm of problem-solving, participate in language and professional interaction. That is why the particular importance here acquires the possibility to combine individual and group work of students on solving professional problems in educational environment.

It is important to provide these problems by mining science, and with their help, students can learn about promising lines of mining development. To realize that we used the results of scientific research of higher schools -members of Consortium of Russian raw material universities and Imperial College London in the preparation of cases for study.

At Kuzbass State Technical University and Tomsk Polytechnic University we conducted a number of training seminars for teachers of foreign languages and specialized engineering disciplines for the Mining specialization. Their goal was the development of problems for role-plays, brainstorming, and case-studies. They were based on the results of scientific research in the field of geo-ecology, technology and complex mechanization of mining operations, business management.

In particular, based on the results of geo-ecological studies conducted by the Department of Geology of Kuzbass Technical and Tomsk Polytechnic University, as well as the Department of Civil and Environmental Engineering of Imperial College London, we have developed a number of problem situations: "The use of overburden rocks for the treatment of mine and quarry water", "Formation of artificial filter arrays", "Low-cost technologies of cleaning quarry and mine waters" [16-19].

Based on the research of Mining Machines and Complexes Department of Kuzbass State Technical University, we have formulated the following topics for problem discussion: "Underground Geo-Walker", "Active cutting tool" [20-23] and "Multiple use of rock cutters" [24].

Scientific research conducted by Open Cast Mining Department of Kuzbass State Technical University, allowed offering the following topics: "Land-saving open geo-technologies", "Transportless development of coal deposits by open pit mining", "Coal loss reduction during the work of excavator" [25].

To expand the horizon of knowledge and get acquainted with the works of foreign scientists, we have prepared topic "Neo-industrial technologies" [26-32].

Research in the field of Engineering Economics, conducted by the Department of Economy of Tomsk Polytechnic University, allowed offering the following ideas for problem discussion: "The development of state leasing and factoring in coal industry", "The establishment of Coal Regional Bank", "Attracting foreign investment in coal industry" [33-36].

Brainstorming, being very interesting and productive technic in terms of efficiency of professional and common cultural competence formation, is also frequently used in teaching process of subjects in a foreign language at Kuzbass State Technical University and Tomsk Polytechnic University. Without dwelling on the details of the organization and conducting brainstorming session, we would like to describe, as an example, the task offered to students for the brainstorming discussion.

The problem is the following: a small coal mine with spillway pit water into the stream is forced to carry out their treatment, obeying environmental requirements. However, the construction of sewage treatment plants is expensive enough project that can endanger other investment projects. The construction of artificial filter arrays can cost much cheaper, but requires the machinery and equipment used for another purposes. What should the technical management of the coal mine do?

The advantage of the brainstorming technic is an ability to "think loud" in a foreign language provided to students during the brainstorming session. Since the rules of brainstorming provide finding a significant number of solutions (including absurd ones) to professional problem even students with low language level could take part in the discussion.

We would like to touch briefly method "653", which is mainly based on the principles and rules of brainstorming. It's better to use it when there is a need to develop collective solution of the problem and the group demonstrates high language skills [37].

Method "653" is carried out in a group of six people, which generate three solutions of a given problem within five minutes. These ideas are recorded on paper and then transferred in a clockwise direction to each other. Each participant studies the received information next five minutes and details it. The process continues as long as each member of the group has not studied and corrected all the proposed ideas. Finally the group has 18 proposals of detailed solutions to the problem. Further the students discuss, specify and select the best decision.

The advantage of using method "653" is to obtain in a short time a large number of ideas in a foreign language. The disadvantage is frequent duplication of ideas, as at the first stage obvious ideas are expressed by many students. You must also bear in mind that not all students will be able to offer 3 ideas in 5 minutes written in a foreign language. So it should be emphasized once more that this technic should be used in group with higher language skills which allows achieving the best results.

Along with those mentioned above, one of the changes in the system of higher education should be growing mobility of students, teachers and staff, and an international open policy for universities. This increases the role and importance of foreign language skills. However, we observe a significant reduction of in-class learning in new curriculum for the future mining engineers, and increase of their individual work. Consequently, there is a serious problem of competence formation at the foreign language classes. In connection with that this process moves towards an independent and extracurricular work. At the lesson the teacher can use interactive technics such as role-play, brainstorming, case-study, and one of the forms of extracurricular work is the project technic.

The result of students' individual work in "Foreign Language" discipline is the development of projects for technical re-equipment of enterprises, promotion of coal products in the market, and others, as well as the presentation of these projects. Practice shows that individual self-study provides an opportunity not only to realize oneself as a researcher, but also to train future professional competence during presentation and discussion of projects, reports, abstracts.

Each of the above-described technics for the formation of future mining engineers' competencies at technical higher school has its advantages and disadvantages that should be considered by a teacher while organizing the educational process. Therefore, sharing experiences and teaching materials in this area can greatly help teachers to make learning process more interesting, and mostly focused on the formation of particular competences.

4. Conclusion

Thus, the use of innovative technics for the formation of common cultural and professional future mining engineers' competencies is intended not only to accelerate their entry into the global educational and cultural space, but also improve the quality of mining higher education.

5. Acknowledgement

The research was made in National Research Tomsk Polytechnic University with financial support of the Ministry of Education and Science of the Russian Federation in the framework of scientific research "The evaluation and improvement of the social, economic and emotional prosperity of senior citizens" contract № 14.Z50.31.0029. Some parts of research were made in Kuzbass State Technical University with financial support of the Ministry of Education and Science of the Russian Federation in the framework of scientific research "Exploring the parameters of technological and technical solutions for selection and development of improving cutting and extracting mining machines operation efficiency in Kuzbass", contract №632. The authors would like to thank to prof. Yury Lesin and prof. Magerram Gasanov for their discussions during the study. We thank anonymous referees for constructive and useful comments on the papers sent via e-mail.

References

- [1] Corban E and Lowson D 2009 Globalization and modern education *Journal of ECUP* **3** pp 56–62

- [2] Irvine E 2007 New approach to high education modernization: a world competition *Journal of ECUP* **6** pp 91–102
- [3] Hirvonen M 2006 Bologna challenges: a new outlook *Journal of ECUP* **4** pp 76–85
- [4] Alatartseva E and Barysheva G 2015 Well-being: Subjective and Objective Aspects *Procedia - Social and Behavioral Sciences* **166** pp.36-42
- [5] Raven J 1984 *Competence in Modern Society: Its Identification Development and Release* (Oxford England: Oxford Psychologists Press) 354 p
- [6] Brinker T 2009 Key competences professional ability and Bologna process *Journal of ECUP* **6** pp 106–115
- [7] Vaughan D *Learning outcomes and competencies. The results of teaching and competence approach* (London: Collman Pub.) 288 p
- [8] Christensen C M and Eyring HJ 2011 *The Innovative University: Changing the DNA of Higher Education from inside out* (Denver: Jossey-Bass) 513 p
- [9] Bloom B S 1971 *Handbook on formative and summative evaluation of student learning* (New York Mc Grow-Hill Book Co) 211 p
- [10] Bötteher W 2011 *Wissen Kompetenz Bildung Erziehungoder was? ZurDiskussion um Standardisierung in der allgemeinbildnen Schule* (Opladen: Leske&Budrich) 320 p
- [11] Herzog R 1998 *Redezur Eröffnung des Paderborner Podiums* (Heinz Nixdorf Museums Forum am 9 Juni 1998 Hannover) 548 p
- [12] Hutmacher W 2009 *Key competencies for Europe* (Report of the Symposium Berne Switzerland 06-07 May 2009 Council for Cultural Cooperation CDCC a Secondary Education for Europe Strasburg) 103 p
- [13] Kohler J 2004 *Universität Greifswald Schlüsselkompetenzen und "employability" in Bologna Prozess Konferenz Schlüsselkompetenzen* (Schlüsselzumehr Aus Bildungsqualität und Beschäftigungsfähigkeit Heidelberg 22 und 23 Januar 2004) pp 241-248
- [14] Romiszowski A J 2011 *Producing instructional systems Lesson planning for individualized and group learning activities* (Liverpool: Kogan Page Nichols Pub) 322 p
- [15] Schwarz-Hahn S and Rehburg M 2003 *Bachelor und Master in DeutschlandEmpirische Befundezur Studienstrukturreform Wissenschaftliche Zentrumfür Berufs – und Hochschulforschung –* (Kassel: Universität Kassel) 356 p
- [16] Lesin Y V Luk'yanova S and Tyulenev M 2010 Mass transfer of dispersed particles in water filtration in macro-grained media *Journal of Mining Science* **46 (1)** pp 78-81
- [17] Lesin Y V, Luk'yanova S Y and Tyulenev M A 2015 Formation of the composition and properties of dumps on the open-pit mines of Kuzbass *IOP Conference Series: Materials Science and Engineering* **91 (1)** 012093
- [18] Tyulenev M A and Lesin Y V 2014 *Justification complex purification technology open-pit mines wastewater* (Symposium of the Taishan academic forum – Project on mine disaster prevention and control) pp 441-444
- [19] Tyulenev M, Zhironkin S and Litvin O 2015 The low-cost technology of quarry water purifying using the artificial filters of overburden rock *Pollution Research* **34 (4)** pp 825-830
- [20] Aksenov V V, Khoreshok AA and Beglyakov VY 2013 Justification of Creation of an External Propulsor for Multipurpose Shield-Type Heading Machine – GEO-WALKER *Applied Mechanics and Materials* **379** pp 20-23
- [21] Khoreshok AA 2002 On side cutting bit when operating at sheerer drums *Ugol'* **7** pp 10-12
- [22] Lekontsev Yu M, Sazhin P V Temiryayeva O A and Ushakov S Yu 2013 Two-side sealer operation *Journal of Mining Science* **49(5)** pp 757-762
- [23] Kovalev V A, Gerike B L and Gerike P B 2014 *Preventive maintenance of mining equipment based on identification of its actual technical state* (Symposium of the Taishan academic forum – Project on mine disaster prevention and control) pp 184-189
- [24] Prokopenko S A 2014 Multiple service life extension of mining and road machines' cutters *Applied Mechanics and Materials* **682** pp 319-323

- [25] Zhironkin S A, Tyulenev M A, Zhironkina O V, Hellmer M 2016 The global determinants of mining higher education development *Metallurgical and Mining Industry* **2** pp 62-67
- [26] Tyulenev M, Lesin Y, Zhironkin S and Garina E. 2016 Coal producers waste water purification *Metallurgical and Mining Industry* **2** pp 52-56
- [27] Gasanov M, Gasanov E, Egorova M The Technologies of the Network Prosperity in Russia *Procedia - Social and Behavioral Sciences* **166** pp 103-106
- [28] Gasanov M A, Gasanova N V, Zhavoronok A V 2016 Information Technologies in Ensuring Continuous Wellbeing of the Person *The European Proceedings of Social & Behavioural Sciences* **VII** pp 323-336
- [29] Klemasheva E, Gasanov M and Zeremskaya Y 2016 Neo-Industrialization of Russian Economy as a Source of Social Well-Being Growth *The European Proceedings of Social & Behavioural Sciences* **VII** pp 150-154
- [30] Alartartseva and Barysheva G A What is Well-Being In The Modern Society: Objective View *The European Proceedings of Social & Behavioural Sciences* **VII** pp 375-384
- [31] Baryshev A A and Barysheva G A Social Entrepreneurship: Metaphysics of Entrepreneurship in Practice *The European Proceedings of Social & Behavioural Sciences* **VII** pp 352-365
- [32] Barysheva G A and Novoselova E G 2014 Methodology of Application of the Structural Shift Mechanism for Regulation of the National Economic Management System *Applied Mechanics and Materials* **682** pp 550-554
- [33] Zhironkin S A 2002 Prospects and new possibilities investment attracting to Kuzbass coal mining industry *Ugol'* **6** pp 31-36
- [34] Zhironkin S A 2001 Factoring and leasing development at coal mining industry of Kuzbass as an important element of its financial part *Ugol'* **4** pp 29-30
- [35] Zhironkin S A 2001 Governmental factoring development of TEK Kuzbass *Ugol'* **6** p 62
- [36] Zhironkin S A 2002 About measures of vixel circulation development and vixelability definition of fuel-and-power complex' enterprises *Ugol'* **4** pp 47-48
- [37] Kohn N and Smith S M 2011 Collaborative fixation: Effects of others' ideas on brainstorming *Applied Cognitive Psychology* **25** **3** pp 359-371