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Effective capacity building by empowerment teaching in the field of occupational safety and health management in mining

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The paper is dealing with a developed concept named Empowerment Teaching, which is based on practical teaching experience gained in various mining universities. It is demonstrated that this concept can be used to increase the effectiveness of knowledge transfer to mining countries in the world, as well as to overcome cultural barriers between lecturers and their students. The two models of participatory training, which are proposed to be named “physical” and “emotional” models, are portrayed. The authors are convinced that participatory training methods can be an ideal answer to a challenge associated with workers’ competencies in mining, namely – the potential of highly motivated and well-educated young academics is often diminished by a lack of ability to apply their knowledge. A special emphasis is made on the possible application of empowerment teaching for educational and training activities in the field of occupational safety and health (OSH), which is a matter of utmost importance for the mining industry. Several benchmarking initiatives in the field of OSH (“safety culture”, zero-accident vision) are underlined to be encouraged and promoted by means of new teaching methods. The examples of successful international cooperation among universities are given, as well.

Key words: mining education; participatory training methods; empowerment teaching; management systems; occupational safety and health

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Introduction. Mining education has changed a lot by effective transfer knowledge in recent years. Changes come from effective collaboration among countries, technical and infrastructure development, methods of training, as well as actions taken by professional communities (Society for Mining, Metallurgy and Exploration (SME, USA), Institute of Materials, Minerals and Mining (IOM3, UK), Society of mining professors (SOMP) and others.

UNESCO’s strategic approaches to achieve Sustainable Development Goal 4 (“Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all”) on education are presented in “Education 2030” Framework for Action [12] and may be summarized as follows:

- strengthening policies, plans, legislation and systems;
- emphasizing equity, inclusion and gender equality;
- focusing on quality and learning
- promoting lifelong learning
- addressing education in emergency situations.

Some recent publications (for example, [1]) illustrate the applications of several aforesaid approaches through the lens of modern mining education:

- the global focus of training, i.e. graduates are prepared to work worldwide, which requires similarity of educational programs and mutual recognition of diplomas. Mining education programs are developed in order to meet the changing demands of the national and global mining industry by the graduates, theoretically trained in mining engineering and capable of quick progress under adequate guidance.

- opportunity to shape an individual educational pattern, based on the selection of relevant elective courses;

- provision of academic mobility for students, mutual recognition of credit units earned in different universities;



- wide application of modern educational technologies, computer facilities for 3D-modelling of deposits and design, electronic information resources;
- realization of the ‘lifelong education’ concept, i.e. acquisition of fundamental knowledge, skills and competencies at a certain stage of education and regular improvement of qualification in the course of a career;
- availability of all types of courses and programs (anyplace, anytime);
- active involvement of the professional community in the process of training and continuous
- professional development of engineering personnel.

Obviously, the shortage of qualified executive staff and specialists in the mineral-resources sector is not only a limiting factor for the development of national economies but also a cause of death of workers and large-scale environmental pollution as a result of industrial accidents.

Today’s mining companies recognize that continuous performance improvement necessary to achieve the “zero accidents” goal means going beyond what’s required by laws and regulations [13]. To accelerate the pace of mine safety improvement, mining companies and universities worldwide take steps to implement best practices that encourage a ‘culture of safety’ by means of new teaching methods [11].

The very paper summarizes a 10-year experience gained by Technische Hochschule Georg Agricola University (THGA) in the application of participatory training method in many countries in Europe, Japan, Asia, Latin America and Africa.

Modern osh management systems. The importance of introducing modern occupational safety and health (OSH) management systems at the level of organization is now recognized by governments and employers. Occupational safety and health is a matter of utmost importance for the mining industry, for the high levels of occupational accidents and diseases remain a major source of concern, impacting on productivity and competitiveness, as well on social protection systems.

The guidelines designed by the International Labour Organization (ILO-OSH-2001) [2] provide a framework for OSH management system applicable on both a national and an organizational level. The guidelines are based on international recognized principles concerning OSH defined by the ILO’s tripartite constituents. This tripartite approach shall provide the management system strength and flexibility, and the necessary basis to ensure a sustainable safety culture in the organization. According to the Guidelines, the involvement of employers, employees and the competent authorities allows for continual improvement of the organization’s OSH performance. The guidelines are not legally binding, but are instead meant to be used as a framework for (preferably supported by national laws and regulations) establishing an OSH management system, based on the plan-do-check-act methodology. This methodology allows for continual improvement of the organization’s OSH management system. ILO-OSH-2001 do not provide detailed specification for the design of the OSH management system, but rather a generic assistance for organizations to either establish or improve their OSH management system. The effectiveness of the proposed OSH management system is entirely dependent on the motivation and competence of organization choosing to incorporate the guidelines in their safety management system.

The standard OSHAS 18001:2007 [8] in fact is very similar to ILO-OSH-2001. They are both based on the same plan-do-check-act model and the described management systems do not include any areas of significant difference. There are, however, some minor differences. OSHAS 18001:2007 does not mention the implementation of the described management system on a national level, as the standard is intended for organizations. Further, the safety management system described in the standard is developed in order to be integrated with other management systems, such as ISO 9000:2015 family – Quality management and ISO 14001:2015 – Environmental management.

In March 2018, International Organization for Standardization (ISO) has published a newly developed standard, ISO 45001, Occupational health and safety management systems – Requirements, which has taken into account OHSAS 18001, ILO-OSH-2001 Guidelines, various national standards and the ILO’s international labour standards and conventions. A three year transition period (to March 2021) has been established, so at the nearest future enterprises of the sector of mineral resources are to re-certify their OSH managements system in order to comply with ISO 45001 standard.

Nowadays, modern OSH management systems are successfully implemented at many mining enterprises. At the same time, these systems for mining industry though can be proclaimed but should be implemented carefully and consistently considering the peculiarities and hazards of mining operation. In fact, every change in the technological aspect of mining should be immediately followed by the appropriate changes in safety management [3].

Method of empowerment teaching. Empowerment teaching is a further phase of participatory training methods. The participatory training is an educational process which encourages participants to see themselves as a source of information and knowledge about the real world. The advantages of participatory training methods are supporting learners; especially those come from emerging (mining) countries to build their confidence and self-development for their new knowledge, skills and attitude. Participatory training methods are methods that support social development and change, focusing on information giving or skill – building, as well as encouraging the practitioners and people to articulate their own knowledge and need to learn more [4, 5, 7, 9].

There are some key principles of participatory training, which are:

- it is learner-centered and learner’s learning-need specific;
- learning focuses not only on the knowledge but also on enhancing awareness and skills. This makes the learning complete, critical and useful;
- learning is derived from the experiences of the participants. Experiential learning is crucial to participatory training;
- participatory training requires a learning environment where participants and their experiences are valued and participants feel psychologically secure and safe to unlearn, try their new ideas and share their experiences;
- when participation is valued, participants develop their own norms and values and take responsibility for their own learning.

Since ensuring participation and building a safe environment are key requirements of participatory training, the role of the trainer becomes very crucial. The trainer should not only believe in the participatory principles but must demonstrate it as a way of life.

Some methods, aids and techniques used in participatory training are given in Table 1:

Table 1

Methods, aids and techniques that can be used in participatory training

Methods	Tools/Aids	Equipment	Techniques
Group discussion, lecture, role play, demonstration, etc.	Slides, posters, film clips, models, etc.	Overhead projectors, slide projector, etc.	Plenary discussion (in small group discussion) brainstorming, fishbone, etc.

Selection of methods depends on focuses of learning.

If the focus of learning is increasing knowledge then the methods used are lectures, field visits, demonstration, self-study, etc.

If the focus of learning is increasing skills, then the methods used are practice sessions, demonstrations, apprenticeship and learning by doing.

If the focus of learning is generating awareness then the methods are role-playing, small group discussion, case studies, simulation, learning games, structured exercises, etc.

The application of participatory training methods motivates trainers to find substitution and improvement in teaching. After courses, trainers can gain more experiences and what they have from follow-ups can bring initiatives in upcoming training. Therefore, trainers are empowered in their courses regarding to structure of training, methods, tools and techniques of training to reach the aim of courses.

During multiple training courses, the authors have developed a 7-phase model for an effective international knowledge transfer from forerunner mining countries to emerging mining countries. This model includes two sub-models which may be named “physical” and “emotional” ones.

The 7 physical stages (Fig.1). There are 7 phases in the physical stages, which are (1) start-up phase, (2) warm-up phase, (3) learning and experiencing phase, (4) practical phase, (5) wellness phase, (6) exam phase, and (7) final phase. In empowerment teaching, to achieve successfully aims of lectures, teachers should run the lectures through these phases.

Startup phase is the phase for lectures to explain the framework and necessary commitments for the courses together with students, such as languages. Lectures and students also get to know each other from themselves, their experiences and expectations of the courses. Creating a friendly and cooperative atmosphere before and during lecturing is very supportive for learners, as they can overcome the hesitancy of mentioning their personal point of view and raising questions to teachers, and establish individual role and flat hierarchies, which are requisites to implement participatory training methods.

Warm-up phase must be regarded as a core element of the 7-phase model as communication has a social dimension and is therefore the result of the interactive behavior between lecturers and learners (based on their culture and experiences). The role of lecturers in this phase is to enforce the students’ willingness and abilities to adapt learning progress.

In phase of learning and experiencing, learners are enabled to develop their potential, skills, knowledge and attitudes. Teaching methods must be outlined and explained to the students comprehensively. In empowerment teaching, time and explanation are crucial elements for students to understand new methods, and to implement discussion and repetitions. Lecturers act as moderators when the students provide their own ideas, knowledge and techniques. By their leading of Questions and Answers sections and discussion, lecturers can help the students to understand the content of the lectures.

Additionally to learning and experiencing phase, the practical phase is an integral part in learning process, which includes field trips, practical sessions or discussions with people in practice, etc. As the learning process is not for the examination (in short-term), but for their future lives (in long-term), learners should practice in real cases with suitable solutions, and gain their knowledge and experiences.

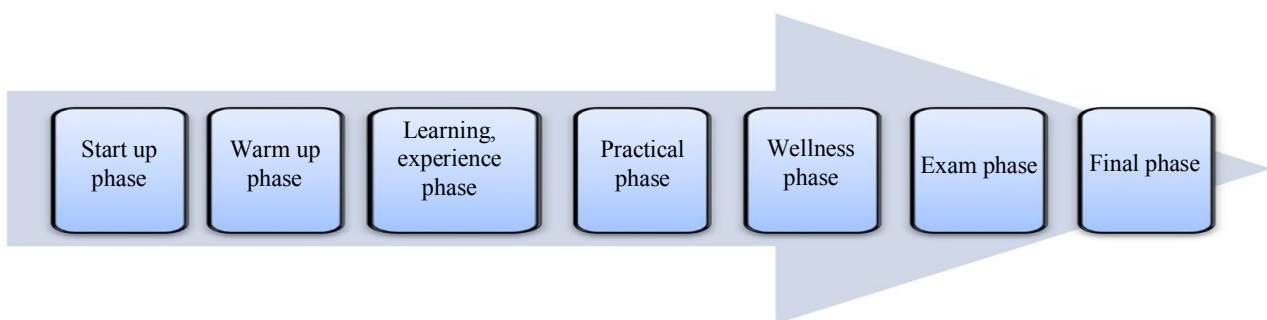


Fig.1. The 7 physical stages of empowerment teaching

To support participatory training and empowerment teaching, lecturers should design a friendly and creative atmosphere not only inside the classroom but also outside, bringing positive experiences for students and help them create best moments to remember, linking with their knowledge.

The exam phase is the phase that summarizes the learning efforts of the students. During the exam, lecturers must be the mentor and coach who encourage the students to transfer their knowledge learned by the participatory training methods back to the audience in form of the audit committee.

The emotional 7-phases-model (Fig.2). Besides of physical stages, lecturers and learners also go through different emotional phases, accordingly. They are (1) neutral phase, (2) skeptical phase, (3) slow approach phase, (4) realization phase, (5) curiosity phase, (6) exciting phase, and (7) emotional phase.

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Neutral phase is the starter phase in lecturing as both lecturers and learners are new to each other.

After this phase, learners are going to skeptical phase, which is one that they keep asking of themselves and rehearsal of what they have learned and accumulated knowledge, and how to adapt new knowledge. Gradually, learners can slowly approach new knowledge by their process of memorizing and understanding. By practicing new knowledge, learners become skillful and they can recognize their ability during practice.

If learning and experience phase and practical phase are those that form knowledge, skills and attitude for learners physically, realization phase and curiosity phase are respectively emotional ones. In these phases the learners can realize themselves better and discovery their implicit capacity. Once they can understand themselves and be confident with their knowledge and capacity they can be exciting to show it off to other people. An examination is not only an opportunity for learners to perform their capacity, but also a phase to highlight the results of the learning process.

To international guest lecturers, when they complete courses, they also drive the learners through different emotional phases. After examinations, lecturers and learners become more open to another, eager to share experiences during the training, and they tend to keep contact among another for further activities and knowledge exchange. The most wonderful memories remain in their minds and can be motivation for them in studying and at work.

However, it is complicate to implement empowerment teaching if the scale of the class is more than 25 students. There could be insufficient time for teamwork at class, as well as for lecturers to observe and exchange ideas with learners, which is an essential factor in motivating learners to be participatory. A large scale of students in classes, therefore, is a challenge for international guest lecturers besides of other economic and technological obstacles in adapting empowerment teaching in emerging mining countries.

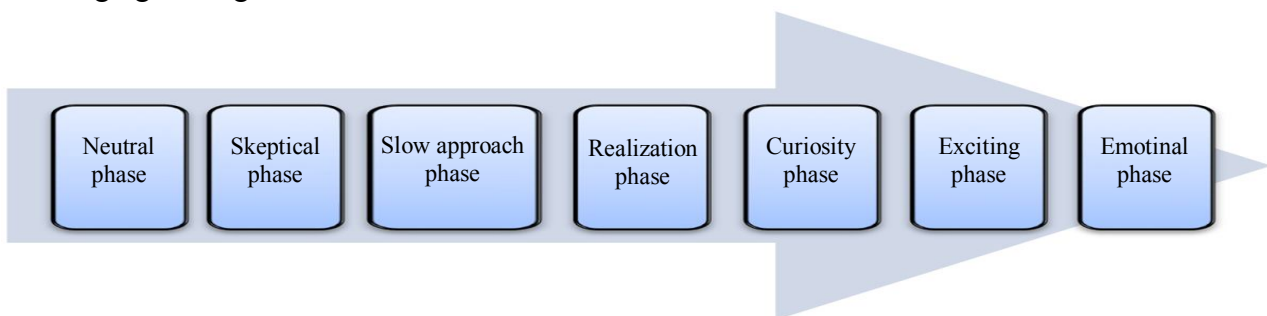


Fig.2. The emotional 7-phase-model of empowerment teaching



Discussion. In fact, empowerment teaching has demonstrated to be more effective in achieving than “traditional” forms of participatory training. In our view, the emotional model is very helpful in “breaking ice” between a lecturer and students, as well as in motivating listeners to be an integral and active part of the process of teaching. Some success stories are given below.

The authors from THGA have been applying empowerment teaching in mining schools for almost ten years, as the development of the initiative from Capacity Building Committee (CBC) of Society of Mining Professors (SOMP). The Committee aims at assisting and advising universities and colleagues in developing regions to achieve capacity building and self-sufficiency in the mineral engineering professions. The authors are the most creative and active members of the CBC and they had been supporting mining universities all around the world, such as: Russia, Colombia, Peru, Thailand, Myanmar, Zambia, Sierra Leone, Japan and Vietnam. It is not only the sending of guest lectures to these universities, but also by sharing information and contacts to get scholarships, training courses abroad, supporting international conferences, and exchanging students. Especially in training, guest lecturers from THGA have been teaching in both short courses and long courses during semesters.

Students in these courses come from different countries, all ASEAN (Association of South East Asian Nations) countries, (Chulalongkorn University case) or from different faculty (Hanoi University of Mining and Geology case), or those who have different English skills (Myanmar mining students) or (South American countries and African countries). However, by empowerment teaching, learners can overcome hesitancy and shyness, speaking out loud their ideas, expressing their thought, and understand requirement of lecturers during the courses both in theoretical and in practical part. Students can also spend the time with lecturers during lecture-free.

In 2018-2019, the training courses on business management systems and strategies for interdisciplinary engineering services have been carried out at Saint Petersburg Mining University (Russia). The two groups of students have been mainly represented the occupational safety and health specialization. The core idea of these courses was to deliver in a participatory manner the key principles and methods of management (Critical Path Method, Gantt chart, Kano-Model, Ishikawa diagram etc) so that the students would be able to improve their understanding of OSH management systems at mining enterprises (see Figures 3, 4 below).

Being a key element to the successful implementation of modern OSH management system, workers’ participation (or in other words “employee engagement”) has been in the focus of training courses in Saint-Petersburg. Being taught the fundamental emotional drivers of employee engagement (pride, recognition, stimulating work, personal development, clarity, positive working environment, and others), the students have demonstrated better understanding on how these drivers could be applied for the purpose of OSH management. Example being the program WISE developed by the ILO [14]. Although WISE was originally created for small enterprises, nowadays the basic principles of WISE are successfully used at many mining enterprises. WISE is based on the concept that working conditions, product quality, productivity and competitiveness are interlinked to strategic issues for small businesses. The use of local “best practices” and the practice of bringing business managers together in groups have proved highly successful in generating solutions involving simple and low-cost improvements that link productivity with a safer and better workplace. This training is effective when it focuses on:

- a multifaceted approach building on local practice;
- positive achievements and feasible solutions which are locally attainable, including low-cost solutions; and
- learning-by-doing, which directly involves managers through group work.

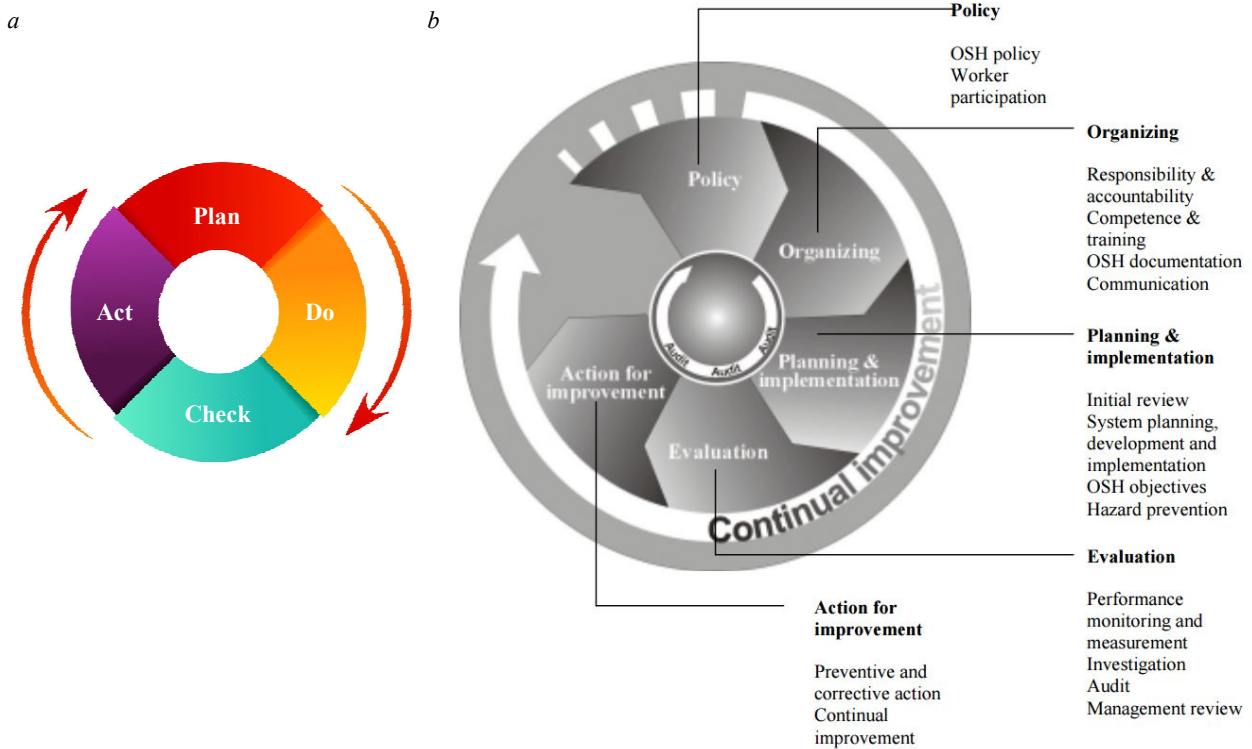


Fig.3. Deming “Plan-Do-Check-Act” (PDCA) cycle: *a* – general scheme; *b* – PDCA cycle in the OSH management system at the organization [2]

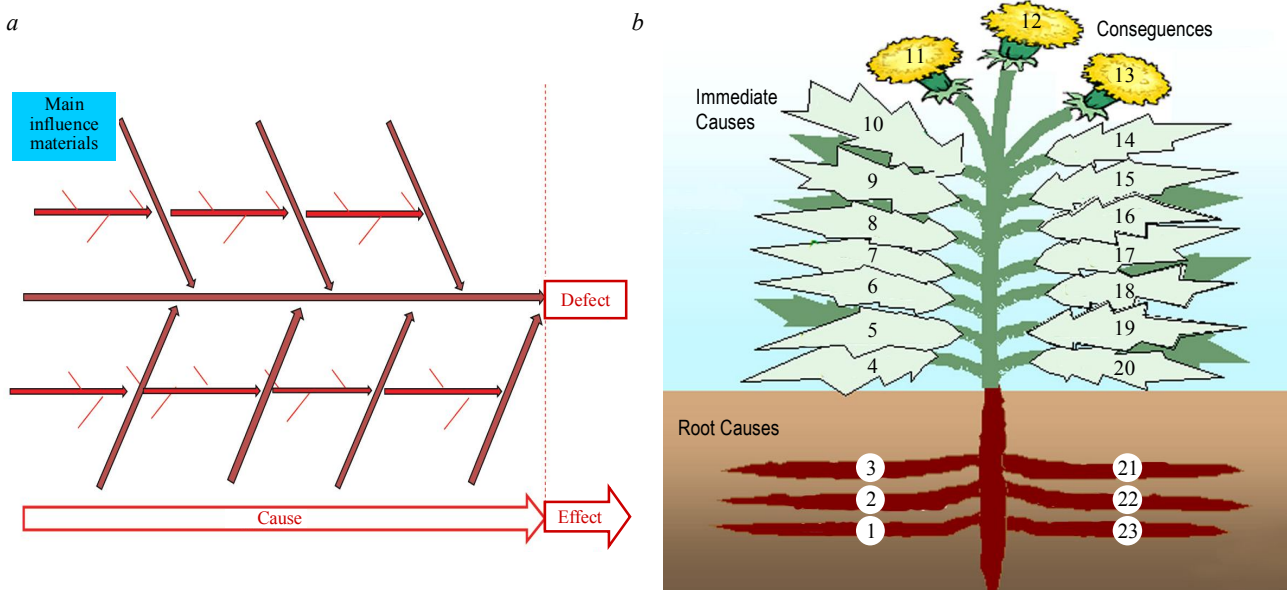


Fig.4. Ishikava diagram: *a* – general scheme; *b* – structure used when identifying the root causes of occupational accidents (Images are taken from open sources)

- 1 – inadequate training plan; 2 – failure of EHS management system; 3 – no inspection/control; 4 – no supervision; 5 – no procedure/instruction; 6 – No training/induction; 7 – defective PPE; 8 – chemical spill; 9 – broken tool; 10 – unguarded machine; 11 – burns; 12 – strains; 13 – cuts; 14 – horseplay; 15 – ignore hazard; 16 – ignore procedure; 17 – use a shortcut; 18 – pay no attention; 19 – distraction; 20 – too much work; 21 – no/lacking management attention; 22 – employee motivation; 23 – wrong priorities

The “six principles” of WISE, which are seen as the key to successful participatory programmes in SMEs, are as follows:

- build on local practice;
- focus on achievements;
- link labour protection with other management goals (quality, productivity);

- use “learning-by-doing”;
- encourage exchange of experience (in groups);
- promote workers’ participation.

For example, at a glance one can hardly enchain the group work of students at Saint Petersburg Mining University (Fig.5, *a*) and pre-shift safety examinations at the coal mining enterprise JSC “SUEK-Krasnoyarsk” (Fig.5, *b*), but both these two procedures are based on the similar principles of empowerment teaching.

It is sometimes said that nowadays the world is in the “third age of safety” [10], meaning that after the attention for technical safety and organisational safety, the focus is since on “safety culture”. This fact makes the method of empowerment teaching more valuable for promoting safety culture issues in the course of training. The differences between traditional accident prevention training and Zero Accident Vision-based safety leadership training are provided in Table 2, which is also based on the teaching experience of Saint Peterburg Mining University.

Table 2

Key points of accident prevention training and Zero Accident Vision training

Accident prevention training	Zero Accident Vision training
Zero accidents is an (unrealistic) goal	Zero accidents is an ambition, a journey
Safety improvement is triggered by internal processes (Plan, Do, Check, Act)	Safety improvement is triggered also by learning from the experiences of others
Safety is designed or prescribed by experts	Safety is co-created by all members of the organisation (having a learning attitude)
Incidents are failures	Incidents are opportunities for learning
Workers’ behaviour (human error) is part of the problem	Workers are empowered to come up with solutions – they are part of the solution
Compliance – “We have external motivation”	Participation – “We want (intrinsic motivation)”

Conclusion. The mining industries and global supply chains associated with them play a key role in economies of many countries, creating jobs, developing national infrastructure. Changes in the mining industry are very fast nowadays due to the revolution in technology and the development of society. Mining education, thus, is required to be adapted both in a content of courses and methods of teaching and communicating with learners in the circumstance of lifelong learning. Empowerment teaching is supportive, for the fact that it provides learners opportunities to discover their implicit capacity and prepare themselves knew knowledge and new skills in the new era.

In particular, there is widespread agreement on the importance of creating and consolidating a “safety culture” as the basis for gradual improvements in OSH conditions [10]. The introduction of

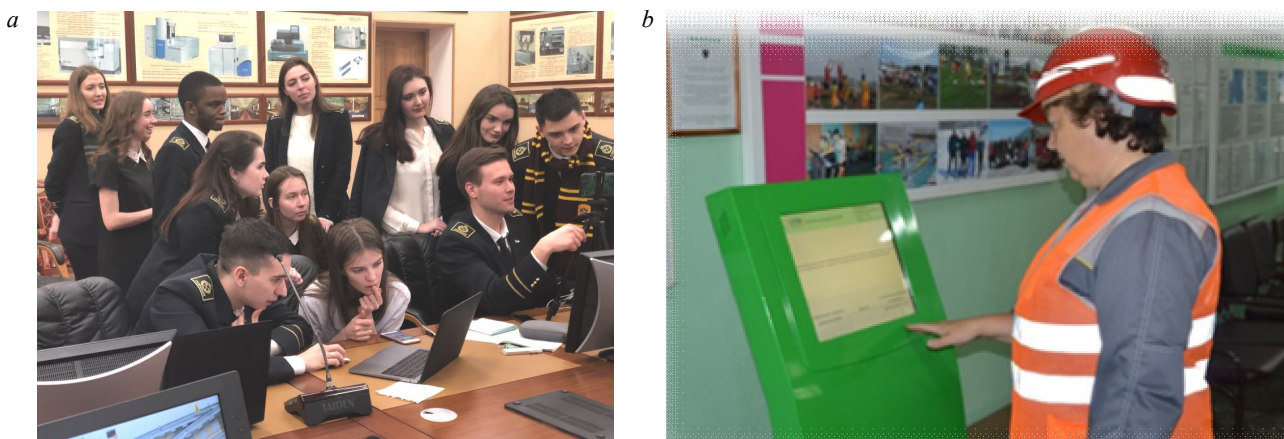


Fig.5. Examples of participatory training methods: *a* – group work at Saint Petersburg Mining University; *b* – pre-shift safety examination at JSC “SUEK-Krasnoyarsk”



OSH principles into university education is therefore essential for mainstreaming preventive functions into professional activities of mining engineers [16].

The international cooperation of universities in the field of mining education opens new ways for carrying out joint research, educational and training activities, and academic mobility of students and teachers.

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