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How to respond to changes in technologies in occupational safety and health experts´ training?

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Abstract

The improvement of the quality and efficiency of education is a basic and indispensable condition of any educational institution. They are facing the crucial role because they must reflect on the changes brought by the fourth industrial or digital revolution. Technological explosion in production requires an urgent reassessment of the perception and functioning of a person - an employee in an intelligent manufacturing environment. The emphasis on education, skills, human knowledge is changing dynamically and will be changing continuously. It is therefore necessary to combine technologies with education and this training also includes work safety, which is an integral part of lifelong learning. The education in work safety must flexibly respond to exponentially changing industry changes, especially in the preparation of experts who can predict hazards, assess the significance of new and emerging risks, and then take management measures to eliminate their potential negative consequences, so that they do not exceed the limits of acceptability. It is obvious, therefore, that the most important, but at the same time the most vulnerable, element of the whole system is man, and therefore the training of experts should be systemic, comprehensive and proactive in relation to changes in industry. The article brings conclusions from relevant surveys in the field of health and safety at work and highlights the potential for quality improvement to align technology requirements and to prepare higher education practitioners for practice.

Keywords:
Education
Occupational Safety and Health
Professionally qualified workers in occupational safety

Schlüsselwörter:
Bildung
Arbeitssicherheit und Gesundheit
Beruflich qualifizierte Arbeitskräfte

1 Introduction

The automotive industry has become the dominant sector in the engineering industry in Slovakia. Slovakia has become the European car superpower, thanks to four world-class car producers: Volswagen (Bratislava), Peugeot Citroën (Trnava), Kia Motors (Žilina) and Jaguar Land Rover (Nitra), which was opened on 25.10.2018.

Nowadays, Europe is at the dawn of the new fourth industrial revolution, which is considered to be the fourth-largest leap forward, and which is why it has been called "Industry 4.0." This is terminology used for the current trend of digitalization and its associated automation of production which brings changes to the labour market (Urdzíková, J., Kordošvá, M. , 2017). The starting point is the new socio-economic behaviour of people and human society, but the consequence and the premise are necessary steps in technological preparation with the use of the latest cybernetic and other modern technologies and methods. Industry 4.0. refers to an extensive transformation of the whole sphere of industrial production through the integration of digital technologies and robotics with the conventional industry (suppliers, factory, distributors, even the product itself) into a highly integrated value chain. It is a completely new philosophy that brings global change and covers a whole range of areas from industry, through the area of technical standardization, safety, educational system, legal framework, science and research to the labour market and the social system (Člerny, 2017).

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Digitization and the 4th Industrial Revolution put the world of work under substantial changes not only in Slovakia but also throughout Europe. Industry 4.0 will be involved in all areas of human life and it is bound to bring even bigger changes. The area of education and safety is not an exception. The society needs not only people who will create the technology, but especially those who will be able to use it. Therefore, a change of the educational system is also necessary and today's education is already unable to meet the demands made on graduates (secondary or tertiary education) (Hirsch-Kreinsen, 2016).

2 Education and training in Slovakia

The system of education and training in Slovakia is the result of a long-term development and represents a set of all school institutions, their functioning and means (including legislative ones) that ensure the functioning of education and upbringing. It consists of basic education and further education linked to the level of education achieved in basic education, which is managed and administered by the Ministry of Education, Science, Research and Sports of the Slovak Republic. Primary and Secondary Education comprise regional schools, i.e. comprise education and upbringing in kindergartens, primary schools, secondary schools, primary schools of arts, language schools, schools for children and pupils with special educational needs and other educational facilities, which is carried out in accordance with Act no. 245/2008 Coll. on Upbringing and Education and on the amendments and supplements to relevant acts (Act no. 245/2008 Z. z., 2008) , which is also known as the School Act (Figure 1).

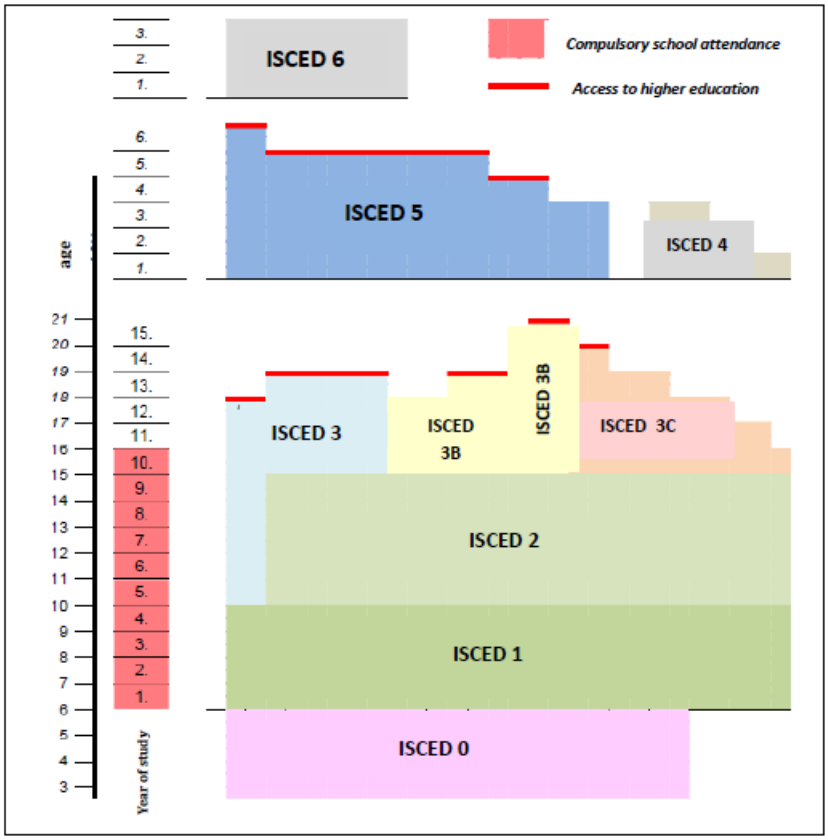


Figure 1 The system of education and training in Slovakia (JOBTOUR, 2011)

Explanatory Note

ISCED 0	Kindergarten	**ISCED 3B**	Secondary vocational schools
ISCED 1	Primary school 1st grade	**ISCED 3C**	Secondary vocational schools
ISCED 2	Primary school 2st grade	**ISCED 4**	Post-secondary studies
ISCED 3	High school	**ISCED 5**	Colleges, universities
ISCED 3A	Conservatory	**ISCED 6**	PhD studies

Tertiary education is represented by universities. The mission of higher education institutions, which are a part of the European Higher Education Area and the Common European Research Area, is to develop a harmonious personality, knowledge, wisdom, good and creativity in man and to contribute to the development of education, science, culture and health for the welfare of society as a whole and thus to contribute to the development of a knowledge-based society. The main role of higher education institutions is fulfilling their mission is the provision of higher education and creative scientific research or creative artistic activity. Higher education is carried out in accordance with Act no. 131/2002 Coll. on Upbringing and Education and on the amendments and supplements to relevant (Act No. 311/2001 Z. z., 2001).

2.1 Education of occupational safety experts

The importance of education and upbringing of the young generation in the field of health and safety - OSH is now undeniable in all countries of the European Union. Education and upbringing in the field of occupational health and safety must take place not only at all levels of education, but as societal requirements show, it is necessary and desirable to create conditions in the system of continuing education of the population within this educational field. The required quality of the OSH education can only be achieved if a competent and responsible approach of training institutions and their teachers is used to develop the professional knowledge of the learners or trainees and their responsible approach to developing desirable attitudes, skills and habits related to the OSH issues (Hašková, A., Tureková, I., Depešová, A., 2015). It is obvious that systems and forms of education must also be subordinated to the needs of society and must reflect on the change in technology brought by the 4th Industrial Revolution (Moavenzadeh, 2015) (van Dijk, F. J., Bubas, M., & Smits, P. B., 2015).

Apart from the training of teachers for primary and secondary schools, Constantine the Philosopher University in Nitra also tutors, trains and educates specialists with non-teaching professions. For several years, the Faculty of Education of Constantine the Philosopher University in Nitra has been preparing undergraduate students – future bachelor programme graduates who have a wide employment options not only in pedagogy but also in other fields of state administration, occupational safety and health inspectorates, in the industrial sphere as safety technicians, in the field of integrated safety, etc. via one-year bachelor study programme "Occupational Safety and Health" (Tureková, I. & Bánesz, G., 2015). Within the framework of comprehensive accreditation, the OSH study programme needs to be revised and modified to meet new requirements. The scope of this study programme was initially based on the fundamental question: What should the OSH student be like to succeed on the labour market? These questions were answered by the graduate profile (Tureková, I., Kozík, T., Bulla, R., 2015):

"Graduates of the undergraduate study programme "Occupational Safety and Health" are able to analyse problems and opportunities that open up in different areas of the occupational safety, design and implement OSH systems, they have skills and capabilities to integrate them into other systems (e.g. environmental, quality, etc.) alternatively to incorporate other systems in them. They are familiar with risk management in a complex man - machine - environment system and they have an ability to choose and apply appropriate methods of risk analysis in the individual subsystems. This requires knowledge of business, organization and management."

Theoretical knowledge

A Graduate of Occupational Safety and Health programme:

Gains knowledge and understanding of the essential facts, concepts, principles and theories related to OSH, basic information on valid OSH legislation in the Slovak Republic as well as within the EU, is able to apply them in the assessment and risk analysis as well as to choose an appropriate method of this analysis, is able to determine procedures and propose appropriate measures to minimize risks to their acceptable level based on their theoretical knowledge and practical experience, is able to evaluate the stress factors affecting occupational safety and human productivity and to assess the undesirable influence of stress factors and is able to apply correct educational methods, principles and forms in specific educational activities within the OSH field.

Practical skills

A Graduate of Occupational Safety and Health programme acquires the ability to:

- Specify, design and implement the OSH systems,
- evaluate these systems in accordance with the general OSH attributes,
- implement the requirements of statutory regulations and directives in the OSH systems,
- manage and improve the OSH systems as well as apply appropriate tools to improve the overall level of occupational safety and health

Additional knowledge and skills

A Graduate of Occupational Safety and Health programme is able to:

- work efficiently as a team member,
- understand and quantify the essential elements of the problem,
- organize their own further education,
- keep themselves familiar with advancements in their discipline,
- use knowledge from science and research.

The graduate is able to follow new findings in rapidly evolving disciplines in the field of OSH. They will gain practical knowledge from practice and laboratory tests that can be conveniently used in their future profession.

A graduate of the OSH programme is competent to perform work of a safety technician, an engineering technician, an occupational health and safety inspector, as well as other professions within the local government and state administration.

Depending on the achieved pedagogical skills, the graduate is also able to apply to various educational activities related to the field of OSH.

As apparent from the graduate profile, there has been a shift towards practice and the knowledge of management systems, specifically risk management. The goal is to apply graduate's knowledge mainly knowledge which forms the basis for risk management of new technologies, including the implementation of learning outcomes in practice in different business entities. The management systems, including risk management (STN ISO 45001, 2018) need to accommodate to changes in technology. This means that the university can prepare a graduate for practice, but only via real-life practice they can gain experience. A part of their profession is continuous lifelong learning to properly address new and emerging technology hazards and to propose optimal and best possible measures to prevent accidents and damage to health at work (Saari, 1995).

When comparing the above-mentioned form of study and focus of the OSH study programme at the Department of Technology and Information Technologies of Constantine the Philosopher University in Nitra, we find similar study departments abroad, especially in the following countries and their universities: the Netherlands - Delft University, Germany - BUGH Wuppertal, France - Australia - La Trobe University, Australia - University of Alabama, USA - University of Michigan, USA - University of Washington, Canada - Queen's University Kingston, Ontario, Finland - University of Tampere, Czech Republic - VŠB TU Ostrava and others.

In order to perform work tasks for an employer, a graduate of the Bachelor's degree in OSH must complete a course of safety technician within their lifelong training and acquire further professional experience which may lead to the highest degree of professional competence - an authorised safety technician. By this, they become a professionally competent person. The expertise of people providing these services and the ability to educate others and provide high quality consultancy service has significant effect on the quality of management in the organization. The roles of OSH professionals are highly differentiated (Figure 2).

Safety technicians and certified safety technicians perform tasks like security service either as internal staff, or supplier form at a commercial level when these services are ordered by employers for employees. The professional contribution of safety technicians (ST) and certified safety technicians (CST) most often regards professional, methodological, organizational, inspection and coordination and educational tasks as well as other tasks regarding a higher level of safety and health. The conditions for earning a safety technician certificate or certified safety technician certificate are strictly defined by the law regarding OSH. The procedure of gaining the certificate is described in Figure 2 (Regulation n. 356/2007 Z. z. , 2007).

Professional duties and advisory services to ensure the safety and health at work are provided by a safety technician and certified safety technician especially under these employers´ obligations:

- Improve work conditions and adapt them
- Identify a hazard in all actions carried out by employees
- Assess risk and make a written document on risk assessment for all activities carried out by employees
- Ensure that work place, communication, work equipment , materials, manufacturing process, organization of work and work places do not endanger safety and health of employees
- Provide safety checks on technical equipment and a proper maintenance and adjustment of workplaces, tools and technical equipment.
- Ensure that work environment factors (chemical, physical , biological), psychological factors regarding mental workload and social factors do not endanger safety and health of employees
- Eliminate hazard and if to scientific and technical knowledge not possible, take measures to reduce it and prepare measures for elimination.

- Replace strenuous and monotonous work and work under difficult, unsafe or hazardous working conditions with proper equipment, operating procedures, production processes and improvement of work organization.
- Establish safe working practices.
- Identify and provide protective measures to be taken and, if necessary, identify and provide protective equipment to be used.
- Prepare in writing, regularly evaluate and update if necessary the policy concept of health and safety at work.
- Issue internal regulations, rules on safety and health at work, give instructions on safety and health at work, and more (Act No 124/2006 Z.z., 2006).

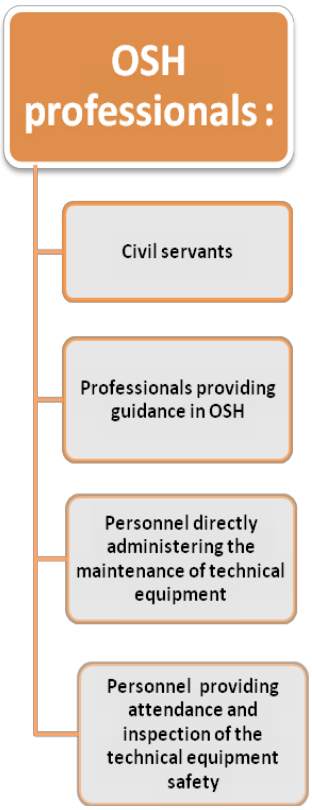


Figure 2 Division of professional workers in the field of OSH

Professional tasks in the field of safety and health at work for an employer who carries out tasks of a higher risk, which can performing cause serious damage to the health of employees or which arise frequently health damage, are independently carried out by a certified safety technician. In the event of a serious accident at work, participation of an authorized safety technician in identifying the causes of this accident is essential (Tureková, I., Bagalová, T., Mračková, E., 2015).

Safety technicians (ST) and certified safety technicians (CST) certificate is issued for an indefinite period. ST and CST are obliged at least every five years after the certification to undergo an upgrade training in the extent of 16 hours under the attendance of a person eligible for education and training and who is a legal entity. Without an acknowledgement of completion of the update training, certificate is invalid (Act No 124/2006 Z.z., 2006).

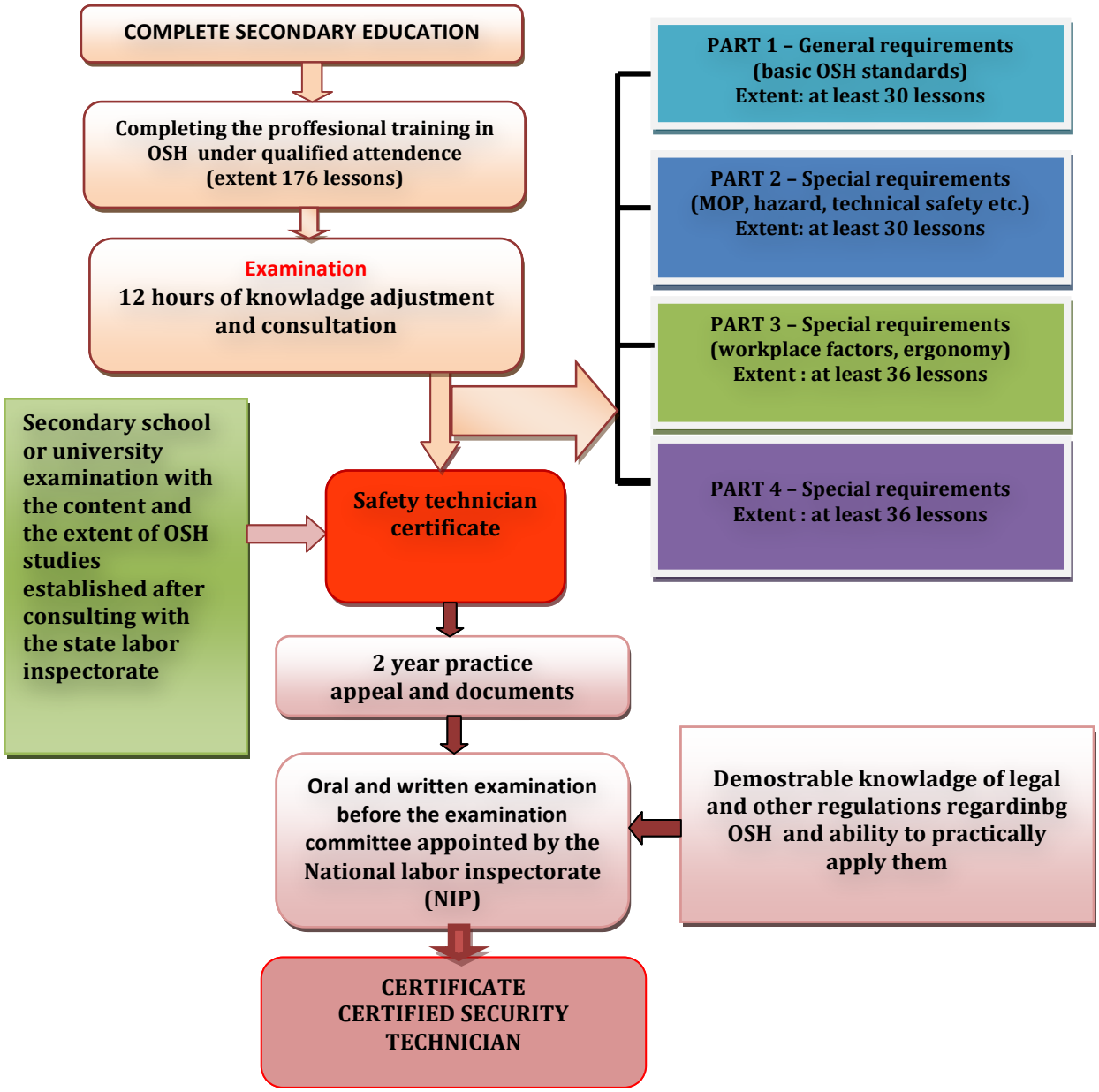


Figure 3 The procedure of gaining the certificate

3 Questionnaire survey

To find out the current status of quality and safety of advisory and technical services from the perspective of the audited entity - labour inspectors, the authors put together the pilot project. To obtain the necessary evidence base anonymous and voluntary questionnaire was used with the application of Internet communication with labour inspectors (Act No 125/2006 Z.z., 2006).

The aim of the pilot project was to determine how labour inspectors who work professionally at the Labour Inspectorate perceive the activities of the safety technicians in terms of educational achievement, quality of work and experience. There is a direct communication between many of the inspectors and safety technicians during inspection executions, advisory services provisions, or during various educational activities. The results of the survey conducted in the pilot project were implemented into the design of OSH program for OSH.

The survey was conducted on a group of 35 respondents, 8 of which were women, representing 23 %. All respondents work as labour inspectors. The questionnaire was divided into 4 parts in terms of focus issues:

a) 7 questions of a general nature were aimed at gathering the views of labour inspectors on the perception and evaluation of the quality of educational institutions, organization of various courses, availability and diversity among OSH literature.
b) 4 questions were aimed at learning the opinions of experts on the content and quality of education, where the safety technician certificate is gained in higher education.
c) 13 questions were based on an assessment of subject composition and content of the study program of OSH
d) 3 of the questions, last of which has 7 sub-questions aim at learning what kind of skills and knowledge is expected from fresh graduates who have completed a bachelor´s degree in OSH before entering their first job.

Labour inspectors had the option to comment on asked questions wit: strongly agree (2), agree (+1), do not know (0), disagree (-1), strongly disagree (-2) on the Likert scale used to measure attitudes in questionnaires.

4 Results ad discussion

The results of the questionnaire are shown in Table 1.

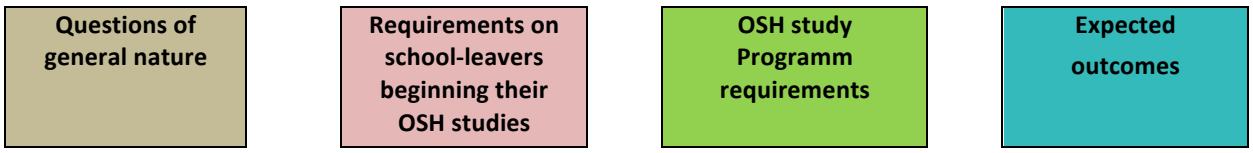
Table 1 Results of the questionnaire survey of selected respondents

No	Question	Answer				
		+2	+1	0	+1	-2
1.	Do you think that safety technicians ought to have particular university education?	**43**	**29**	**3**	**17**	**8**
2.	Do you find the idea of educating professionals in the field of OSH valid?	**77**	**17**	**6**	**0**	**0**
3.	Would you say that the job market has enough qualified safety technicians?	**14**	**9**	**26**	**37**	**14**
4.	Are current professional safety technicians sufficiently knowledgeable?	**0**	**20**	**17**	**54**	**9**
5.	Do you think that safety technician certificates gained at university and other educational institution are equally valid?	**0**	**8**	**29**	**20**	**43**
6.	Do you find the current state of literature on OSH and works published in slovak scientific journals sufficient for experts?	**6**	**14**	**26**	**40**	**14**
7.	Do you participate in any scientific research project regarding OSH along with some other university?	**6**	**9**	**3**	**0**	**82**
8.	Would you say enough attention is paid to the subject of OSH in secondary education?	**0**	**0**	**23**	**23**	**54**
9.	Are graduates of technical schools on a higher knowledge level in terms of OSH than humanities´ graduates?	**31**	**34**	**23**	**9**	**3**
10.	Are secondary school teachers sufficiently prepared to consign information about present-day OSH issues to students?	**3**	**3**	**39**	**49**	**6**
11.	Should the subject of OSH be a part of lifelong learning?	**46**	**37**	**8**	**3**	**6**
12.	Should the subject of OSH be obligatory as a part of training for future teachers?	**29**	**48**	**6**	**11**	**6**
13.	Do you think that education in the field of OSH should also be provided by experts of the field?	68	**26**	**6**	**0**	0
14.	Do you find it important that OSH study programme graduates have lecture or skills?	40	**43**	**11**	**6**	0
15.	Do you think that an OSH graduate ought to have practical experience gained by an internship for example?	57	**37**	**0**	**3**	3
16.	Do you find 2 weeks (80 lessons) to be a sufficient length for a scientific practice throughout bachelor studies?	3	**8**	**26**	**26**	37

Table 1 Results of the questionnaire survey of selected respondents - sequel

17.	Do you find it necessary that OSH students graduate from a practice at work inspectorate?	0	**27**	**30**	**27**	16
18.	Should ergonomics be a part of OSH study programme?	23	**43**	**31**	**3**	0
19.	Should laboratory exercises aimed at measuring and evaluating work environment factors be a part of the subject?	6	**51**	**34**	**3**	6
20.	Should OSH management be a part of OSH studies?	35	**44**	**12**	**9**	0
21.	Do you find risk management an important part of the OSH study programme?	51	**43**	**6**	**0**	0
22.	Should bachelor thesis be practically applied with concrete designs?	43	**34**	**20**	**3**	0
23.	Should civil defence be a part of the OSH study program?	9	**37**	**34**	**11**	9
24.	OSH is an applied scientific field in which scientific monographs are achievable, especially at university level. Do you agree?	23	**51**	**20**	**6**	0
25.	Do you find it important that OSH study program graduates speak at least one foreign language?	20	**63**	**6**	**8**	3
26.	Do you find it important that OSH study programme graduate knows the OSH legal framework and its definition?	73	**24**	**3**	**0**	0
27.	In your experience, which of these skills do current safety technicians lack in:					
	– communicativeness	26	**13**	**26**	**16**	19
	– work consistency	35	**38**	**24**	**3**	0
	– legal regulation knowledge	34	**30**	**21**	**15**	0
	– technical thinking	25	**22**	**41**	**12**	0
	– continuous education effort	40	**29**	**23**	**8**	
	– ability to discuss	22	**11**	**25**	**16**	15
	– ability to solve problems	32	**21**	**20**	**21**	6

demonstration:



The questionnaire revealed the following interesting conclusions:

- Based on the responses to general questions, the education and training of future safety technicians should be carried out at universities. Up to 77% of respondents consider this form of acquiring specialised skills as appropriate, and none of the respondents answered negatively.
- Students of secondary schools usually do not have relevant knowledge and information in the field of OSH, although in the case of technical schools, their students are better prepared than students of humanities. The inclusion of risk education is however, absent in the curricula of many pedagogical faculties, which results in lack of awareness in this area.
- The third group of responses focuses on the content and subject composition of the OSH studies. In general, it can be said that respondents agree with the composition of the subjects that form curriculum of the OSH study programme.
- The last set of questions focused on the real experience of respondents with the quality of safety-related services. Figure 4 depicts the results of respondents' replies.

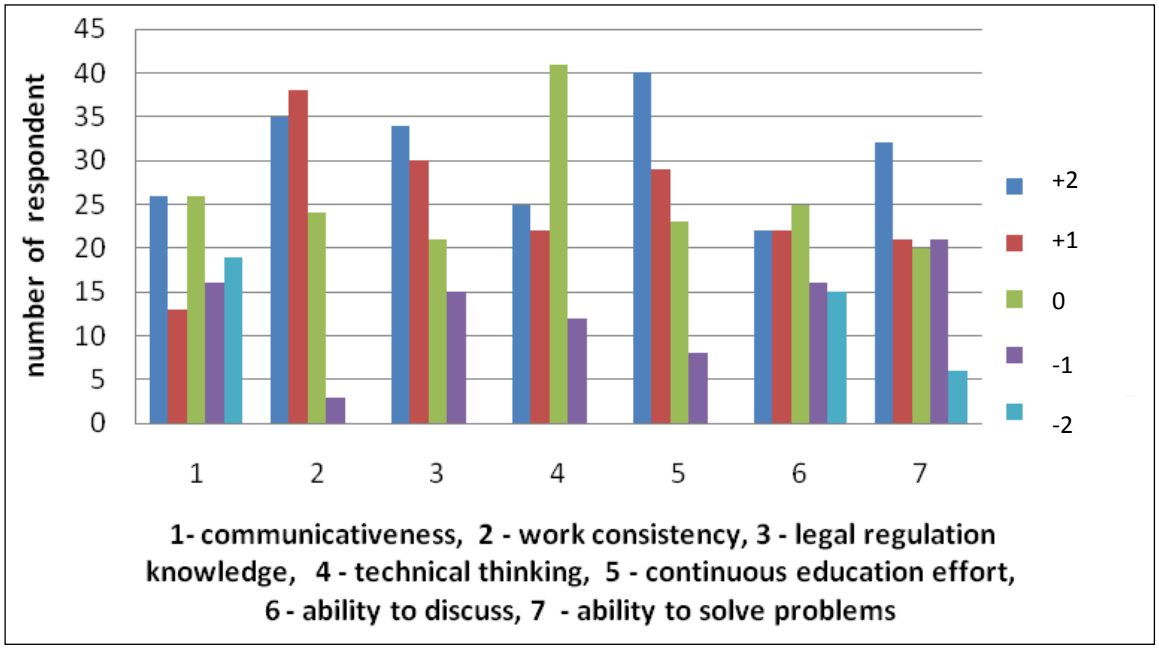


Figure 4 Comparison of the skills current safety technicians lack in

The figure shows that inspectors find lack of continuous education effort, work consistency, legal regulation knowledge and inability to solve problems the most serious issues in terms of the work of safety technicians. 41% of the respondents indicated "cannot judge" regarding the question whether OSH employees lack technical thinking. It is important to consider and stress that inspectors do not care for or inspect the knowledge of the person, but the outcome of their work.

If we were to compare our system of education of safety technicians with other countries, we would find significant differences in the training of these specialists. For this reason, the work performance of a safety technician is conditioned by one's completion of an examination at the National Labour Inspectorate in case of any resident of other nationality.

A comparative analysis of educational and training system of OSH in selected EU countries was carried out in the Slovak Republic in 2017. Project solvers answered these questions:

Is education in safe behaviour and health education in the curricula of selected EU countries? What is the relation between education in safe behaviour and health education to other educational departments or to individual subjects? Is it taught separately, or is it a part of individual subjects or topics?

Education in safe behaviour and health education in general is a common, inseparable and equal part of school curricula in the EU countries. There are two variants:

Variant 1 Education in safe behaviour and health education is comprehensively integrated in the curriculum as a separate educational programme and is usually taught as a separate subject. E.g. in Finland, since 2001, health education has been a separate subject. There is a lot of emphasis on the growing issues of the lifestyle of youth (alcohol, smoking, drugs and non-occupational accidents).

Variant 2 Health education is explicitly linked to other subjects. It is usually declared that health education overlaps with all subjects, or the topics of health education are explicitly incorporated into individual subjects, e.g. natural history, civic education, physical education, work education, etc. For instance Ireland's educational system included health education in the subject of civic education and health education. This subject gives pupils an opportunity to develop their skills, knowledge and abilities, and learn more about themselves, take care of themselves and others and make informed decisions about their health and safety at school, at home, on the street.

5 Conclusion

Practical knowledge confirmed by the research indicates a not ideal level of OSH education on all education levels. It is therefore desirable to create proper conditions for a qualitative change in OSH education on all levels including universities and consider the education in the field of OSH an important factor of life.

Education and training is indirectly related to the quality of services to employers carried out by safety technicians and certified safety technicians. Only a quality curriculum can contribute to qualitative improvement of competent personnel.

It is important to pay attention to the forms and content of OSH education on all educational levels with the aim to provide the school-leavers entering the working process with proper awareness, knowledge and skills which they can efficiently develop in various forms of lifelong learning.

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