

## РОЗВИТОК ВИЩОЇ ШКОЛИ

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J. KALIVODA<sup>1</sup>, L. O. NEDUZHA<sup>2\*</sup>

<sup>1</sup>Dep. «Automobiles, Combustion Engines and Railway Vehicles», Czech Technical University, Faculty of Mechanical Engineering, Technická St., 4, Praha 6, Czech Republic, 16607, tel. +(420) 224 352 493, e-mail jan.kalivoda@fs.cvut.cz, ORCID 0000-0002-0278-2515

<sup>2\*</sup>Dep. «Theoretical and Structural Mechanics», Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan, Lazaryan St. 2, Dnipro, Ukraine, 49010, tel./fax +38 (056) 373 15 11, e-mail nlorhen@i.ua, ORCID 0000-0002-7038-3006

### ENHANCING THE SCIENTIFIC LEVEL OF ENGINEERING TRAINING OF RAILWAY TRANSPORT PROFESSIONALS

**Purpose.** Publication of the results of international scientific and technical cooperation of the Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan (DNURT, Ukraine) and the Czech Technical University (CTU) in the field of engineering training of students on the basis of modern methods of development of scientific and creative abilities of students. **Methodology.** The development of scientific thought and the improvement of the professional level of students of engineering specialties of railway technical institutes may be carried out by different methods both during training and during extracurricular time. One of the methods for improving the scientific level of future engineers is the public lectures of renowned scholars and researchers from leading European higher education institutions, enabling students to have access to world-class advanced scientific idea. **Findings.** The authors have analyzed the activity of DNURT and CTU on scientific and educational preparation of students. It is emphasized that cooperation promotes strengthening of contacts between universities, improves the quality of students' training, is one of the factors of the professional development of future specialists, raising the scientific level of engineering training of railway transport professionals. It is proved that DNURT and CTU duly fulfill the higher education tasks of training of professional personnel who are able to work effectively in the global market, aimed at improving the quality and efficiency of education. **Originality.** This paper presents the analysis of results concerning the efficiency of application of modern methods for engineering training of students of technical higher educational institutions. It gives extended view of the main directions of international education activities. **Practical value.** It is confirmed that popularization of modern methods of propagation of engineering thought among student youth has acquired a new meaning and contributes to enhancing the scientific level of engineering training of railway transport professionals.

*Key words:* engineering training of students; popularization of scientific knowledge; international cooperation

#### Introduction

The development of transport, in particular railways, has a significant impact on the socio-economic life of any state. In Ukraine, the railways conduct a significant amount of transport work (share in the total turnover is more than 85% – Ukrainian railways occupy the fourth place in Eurasia and the sixth in the world by volume of transported goods, and in passenger traffic – 45%); 2% of the total working population of the state is

employed by rail transport. This confirms that the transport industry must move towards innovative changes, to increase its importance as an important transit subsystem on the way of updating not only infrastructure but also strategies for the development of all components of the transportation process, including working in conjunction with other modes of transport [1, 3, 10].

The analysis of the railway industry activity shows that Ukrzaliznytsia occupies a respectable position in the country's economy [1]. This is not without a significant role of graduates of the

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Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan (DNURT) who study in the advanced scientific environment, in conditions of continuous improvement of professional skills and active, creative thinking since the university is the centre of scientific and technological support of the development of the railway industry. DNURT, since its foundation and to date, pays considerable attention to all aspects of student life: research and educational work, since a future railway engineer must possess not only professional knowledge and be a harmoniously developed person, but also have the opportunity to realize his intellectual potential, showing its individual peculiarity [7, 8]. But numerous aspects of joint international activity in the field of trainings of railway students have so far been underestimated due to a number of objective reasons.

### Purpose

Publication of the results of international scientific and technical cooperation of the Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan (Ukraine) and the Prague Technical University (Czech Republic) in the field of engineering training of students on the basis of modern methods of development of scientific and creative abilities of students.

### Methodology

The development of scientific thought and the improvement of the professional level of students of engineering specialties of railway technical institutes may be carried out by different methods both during training and during extracurricular time. One of the methods for improving the scientific level of future engineers is the public lectures of renowned scholars and researchers from leading European higher education institutions, enabling students to have access to world-class advanced scientific idea.

### Findings

Let us consider the historical and methodological principles of the organization and the development of international scientific and technical cooperation of universities on the example of cooperation between the DNURT and the CTU.

In the 30s of the last century, when the process

of industrialization was rapidly gaining momentum and the problem of the lack of skilled engineers became aggravated, a whole network of new higher educational institutions arose, including our university. When creating the DITE (DNURT), it was considered that Dnipropetrovsk is an important transport hub, one of the centres for development of the coal-metallurgical complex. The first 190 engineers-graduates from DITE in 1934 filled up the ranks of specialists in the transport and construction sectors. According to the documents of that time, during their studies at the institute they underwent a serious theoretical training and acquired practical knowledge and skills [4–8]. At present, the following qualities of professional training of an engineer are highly appreciated: ability to establish contacts with people, art of communication, ability to achieve the set goals, competence, creativity, organizational skills, analytical thinking [7, 17]. The training of such a specialist is the urgent task of the university and should be conducted in the synchronous process and interaction of three components: special-professional, fundamental-research and humanitarian. Life expects of a student, future manager, a thorough knowledge of basic general scientific, technical, technological, and humanitarian disciplines [11].

Nowadays, the University has nine faculties in all mode of attendance, about seven thousand students study at the university (<http://diit.edu.ua/>) [4, 5]. DNURT is not only one of the leading technical higher education institutions, but also a powerful research institution in the field of rail transport and transport construction. [17–19]. One of the important tasks of the University is to increase the level of training of specialists, their competence, professional knowledge, computerization of training. The faculty wants the students to master deep special knowledge to meet the socio-economic and spiritual needs of the present day – to become a specialist capable of recognizing true engineering problems, setting complex technical tasks and finding new, highly effective solutions, implementing original technological developments [17–19].

Significant role in this is played by the Research Department (RD) of the University, which, among many activities, carries out the following (<http://diit.edu.ua/>) [8]:

– identification of priority and perspective directions of scientific research at the University;

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– conducting internal and external expert evaluation of projects for carrying out scientific researches;

– organization of work on conclusion of contracts with domestic and foreign customers for the creation of scientific and technical products, the provision of scientific and technical services, marketing research;

– development of business proposals and business plans for the introduction of scientific research into production;

– defining the list of research and development works (R&D), which are promising for implementation in the region and industry;

– conducting fundamental and research studies on natural, social, humanitarian and technical sciences;

– conducting applied researches by orders of domestic and foreign enterprises, institutions, organizations, individuals and initiative RD on solving urgent tasks of scientific and technological development, etc.

To enable a modern specialist to meet the imperatives of our time, in the field of ensuring the connection of scientific research with the educational process, the RD organizes the scientific and technical activities of the students, conducting student competitions, student contests, scientific conferences, which affects the students' progress. The Ministry of Education and Science of Ukraine annually rewards the University for its high achievements in the field of scientific activity and international cooperation (<http://diit.edu.ua/>).

The Dnipropetrovsk National University named after academician V. Lazaryan (DNURT), in the process of entering into the European educational space, devotes much attention to the measures for the future railway engineers to possess not only professional knowledge, but to be a harmoniously developed person, to have the opportunity to realize their intellectual potential, showing their personal properties [7, 9]. In modern conditions, the University administration, among others, considers international activity as one of the priorities of working with students since international cooperation is an important direction for preparing a new generation of specialists in the framework of integration of our country into the world educational space. For this purpose, great attention is paid to the expansion of international contacts, the conclusion of agreements, the organization of interna-

tional conferences, symposiums, the implementation of joint scientific projects, the exchange of experience and information on common issues for higher education institutions [7, 17–19].

Over 90 years of its existence, DNURT is famous for its traditions and innovations [4, 5]. Special attention is paid to the direction of international cooperation with universities of other countries. An example of such cooperation is cooperation with the Czech Technical University (CTU) (<https://www.cvut.cz/>).

The Czech Technical University in Prague (CTU) is one of the largest and oldest technical universities in Europe. His history is closely intertwined with the history of technical education, not only in the Czech Republic, but throughout Central Europe [20]. It was founded on the initiative of Joseph Christian Willenberg on the basis of the order of January 18, 1707 by Emperor Joseph I (Fig. 1, *a*). The training began in 1718; however, it took next 100 years when the engineering professorship was recognized. In 1803, the emperor supported the proposal to turn the engineering and construction school into a polytechnic educational institution (Fig. 1, *b*).

A major event in the history of the educational institution was in 1863, when the first polytechnic specialists graduated from it. The training was now carried out in 4 specialties: hydraulic engineering and road construction, construction of ground structures, mechanical engineering and chemistry. The Czech language began to be used in the teaching process on a par with the German language. Conflicts between the Czech and German halves of the professorship led in 1869 to the division of universities into two separate institutions – the Czech and the German ones. For the Czech institution they built a building and since 1879 the university has received the right to be called technical [20].

Until the First World War, as well as the Czech industry as a whole, the university was developing rapidly resulting in the introduction of new disciplines, which was caused by the needs of society and accelerated technological development. In 1920, the university was renamed as the Czech Technical University, which already had 7 faculties: Engineering, Architecture and Ground-Mounted Construction, Machine and Electrical Engineering, Chemical Engineering, Mining, Forestry and Forest Engineering, Faculty of Special

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Sciences and Commercial Faculty. After the Second World War, a general reconstruction of the CTU took place – some departments became inde-

pendent institutions, the Faculty of Architecture was created in the 70s, and the Faculty of Transport – in the 90s [20].

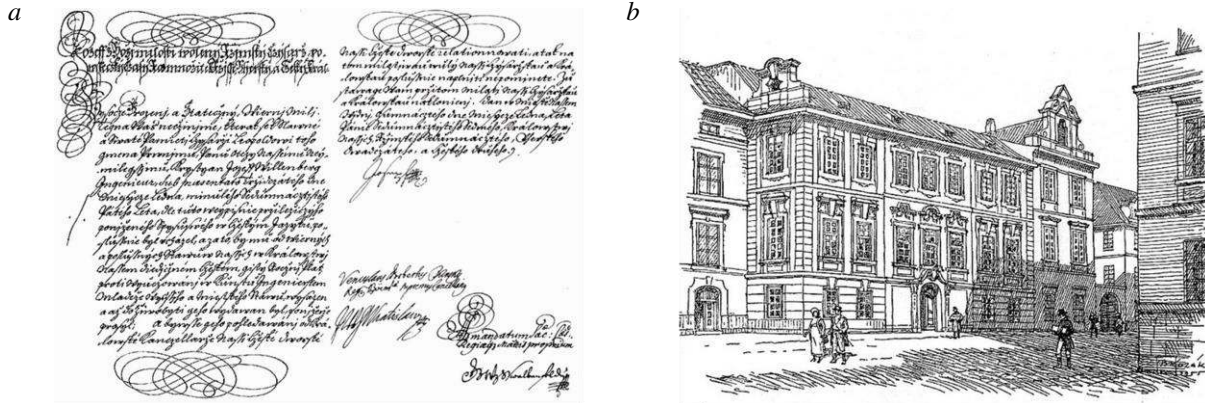


Fig. 1. General view:

*a* – Rescript of Emperor Joseph I; *b* – Prague Polytechnic

Specialists in the field of railway engineering acquire education at the Faculty of Civil Engineering – the Department of Railway Structures and the Faculty of Mechanical Engineering – Department of Automobile, Internal Combustion Engines and Rail Transport. The Independent Department of Railway Vehicles was founded in 1954. This event is inextricably linked with Professor R. Nejejsa – one of the most important personalities of Czechoslovak engineering, science, research and education. He is considered the founder of modern specialized university education in the field of construction of rail vehicles [16, 20].

At present, the CTU has eight faculties (Civil Engineering, Mechanical Engineering, Electrical Engineering, Nuclear Sciences and Physical Engineering, Architecture, Transportation Sciences, Biomedical Engineering, Information Technology), that comprehend more than 20,000 students. The University offers educational programs at three levels:

- three or four year undergraduate program, a Bachelor's Degree after graduation,
- biennial Master's Degree Program – Master's Degree,
- doctoral programs of study lasts three or four years and lead to the Ph.D. (candidate of sciences).

Students of the specialty «Railway Vehicles» acquire and deepen their knowledge in all technical areas, including technical mechanics, material strength, thermodynamics, theory of internal combustion engines, electrical engineering, mechanical and hydraulic gears, motor vehicle theory, etc.

Students acquire deep knowledge concerning the automated design system, numerical simulation of modern rolling stock, and the implementation of experiments in laboratories (Fig. 2) [2, 12–16, 18].

Project-oriented training focuses on the needs of the Czech railway industry in accordance with international standards and legislative requirements. As CTU successfully cooperates with leading global manufacturers of railway vehicles (such as Siemens, Skoda, VÚKV, Stadler, etc.), the companies offer students the subject of student and research projects (Fig. 3), graduation papers, training programs, targeted scholarships. Subsequently, graduates find work as researchers, developers, designers, test engineers and managers in the design, manufacture, testing and operation of railway vehicles [2, 12–16, 18].

During the 2016/17 academic year, CTU offered its students 123 curricula and 464 research areas within these programs (Erasmus Mundus, Erasmus Mundus External Window, Ceopus, Athens, Aktion, etc.). The Czech Technical University has contacts with other universities both in Europe and abroad, within which there are implemented joint programs for obtaining international diplomas. For example, in the 2016/17 academic year, the Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan signed the cooperation agreement with the Czech Technical University, which will strengthen the contacts between our universities (<http://diit.edu.ua/>).

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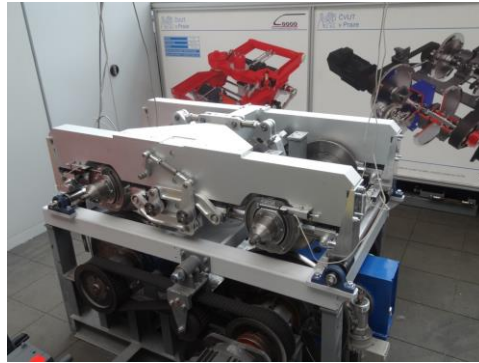


Fig. 2. Roller rig of CTU

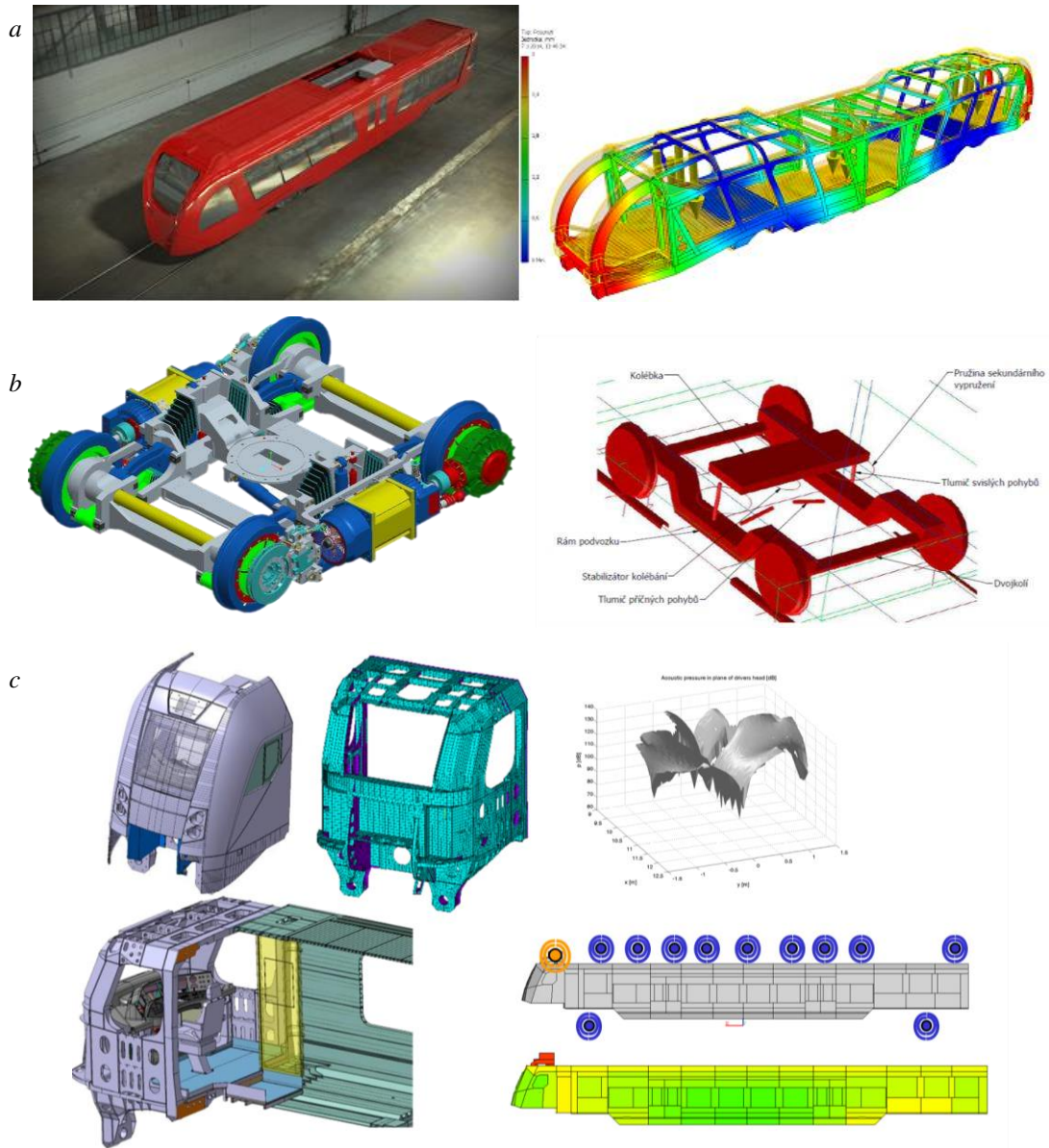


Fig. 3. Examples of some results of students' computer simulation projects:  
*a* – a railway bus; *b* – low-floor tram bogie; *c* – locomotive driver's cabin – noise analysis

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In order for a modern specialist to meet the imperatives of our time, DNURT holds a number of events within the framework of international scientific cooperation (<http://diit.edu.ua/>). Recently one of such events took place – during the days of science at the Mechanical Faculty DNURT held a scientific lecture for undergraduates and graduates on the topic «Railway Vehicle Education in

the CTU» (<http://diit.edu.ua/>). The speaker was Dr. Kalivoda J. from the Czech Technical University. It is pleasant to note that in addition to students of mechanics, the participants also included students from the Faculty of Bridges and Tunnels, Energy Process Management, Organization of Railways Construction, Industrial and Civil Construction (Fig. 4) (<http://diit.edu.ua/>).



Fig. 4. Dr. Kalivoda J. with undergraduates and graduates of DNURT after scientific lecture



Fig. 5. S Undergraduates and graduates during a scientific lecture at DNURT

The scientific lecture was conducted on a high methodological, scientific, educational level, evoked a considerable interest on the part of the listeners. Dr. Kalivoda J. gave full professional answers to numerous questions. Here are just some reviews of participants in the scientific lecture in social networks (<http://diit.edu.ua/>):

– «The conference was held at the highest level with high professionalism and dedication. It allowed us to find out about the Czech Republic, its education and prospects for the development of rail transport...» (V. Babiy, group 339).

– «...You have prepared an international scientific meeting at the scientific level. Thanks to you,

we have learned how today's students are studying outside of our glorious Ukraine and how highly the diploma of DNURT is recognized at the international arena. Such meetings are very useful for us as future specialists. Thank you!» (O. Krasnoshchok, group 347).

#### Originality and practical value

This work presented the analysis of results concerning the efficiency of application of modern methods for engineering training of students of technical higher educational institutions. It

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extended view of the main directions of international education activities.

It was confirmed that popularization of modern methods of propagation of engineering thought among student youth has acquired a new meaning and contributes to enhancing the scientific level of engineering training of railway transport professionals.

### Conclusions

This confirms that international cooperation promotes strengthening of contacts between universities, improves the quality of students' training, is one of the factors of the professional develop-

ment of future specialists, raising the scientific level of engineering training of railway transport specialists. As you can see, the Dnipropetrovsk National University of Railway Transport named after Academician V. Lazaryan and the Czech Technical University adequately fulfil the new tasks set before higher education – training of professional personnel who are able to work effectively in a global market, aimed at improving the quality and efficiency of education.

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Я. КАЛІВОДА<sup>1</sup>, Л. О. НЕДУЖА<sup>2\*</sup>

<sup>1</sup>Каф. «Автомобілі, двигуни внутрішнього згоряння та залізничний транспорт», факультет машинобудування, Чеський технічний університет, вул. Технічна, 4, Прага 6, Чеська республіка, 16607, тел. + (420) 224 352 493, ел. пошта [jan.kalivoda@fs.cvut.cz](mailto:jan.kalivoda@fs.cvut.cz), ORCID 0000-0002-0278-2515

<sup>2\*</sup>Каф. «Теоретична та будівельна механіка», Дніпропетровський національний університет залізничного транспорту імені академіка В. Лазаряна, вул. Лазаряна, 2, Дніпро, Україна, 49010, тел./факс +38 (056) 776 84 98, ел. пошта [nlorhen@i.ua](mailto:nlorhen@i.ua), ORCID 0000-0002-7038-3006

## ПІДВИЩЕННЯ НАУКОВОГО РІВНЯ ІНЖЕНЕРНОЇ ПІДГОТОВКИ ФАХІВЦІВ ЗАЛІЗНИЧНОГО ТРАНСПОРТУ

**Мета.** Оприлюднення результатів міжнародного науково-технічного співробітництва Дніпропетровського національного університету залізничного транспорту імені академіка В. Лазаряна (ДНУЗТ, Україна) та Чеського технічного університету (ЧТУ, Чеська республіка) в галузі інженерної підготовки студентів на базі сучасних методів розвитку наукових та творчих здібностей студентів. **Методика.** Розвиток наукової думки та підвищення професійного рівня студентів машинобудівних спеціальностей технічних вищих навчальних закладів залізничного напрямку можливо здійснювати різними методами як під час навчання, так і факультативно, у позанавчальний час. Одним із методів підвищення наукового рівня майбутніх інженерів є публічні лекції відомих науковців та дослідників із провідних європейських вищих навчальних закладів, що дає можливість студентам мати доступ до передової наукової думки світового рівня. **Результати.** Наведено аналіз діяльності ДНУЗТ та ЧТУ з науково-освітньої підготовки студентів. Підкреслено, що міжнародна співпраця сприяє укріпленню контактів між університетами, поліпшує якість навчання студентів, є одним із чинників їх професійного становлення та підвищення наукового рівня інженерної підготовки фахівців залізничного транспорту. Доведено, що ДНУЗТ та ЧТУ гідно виконують поставлені вищою освітою завдання з підготовки професійних кадрів, які зможуть ефективно працювати в умовах глобального ринку, що спрямовані на підвищення якості, ефективності освіти. **Наукова новизна.** Виконано аналіз результатів ефективності застосування сучасних методів інженерної підготовки студентів технічних вищих навчальних закладів. Розширено уявлення про основні напрямки міжнародної діяльності в галузі освіти. **Практична значимість.** Підтверджено, що популяризація сучасних методів, поширення інженерної думки серед студентської молоді набуло нового значення та сприяє підвищенню наукового рівня інженерної підготовки фахівців залізничного транспорту.

*Ключові слова:* інженерна підготовка студентів; популяризація наукових знань; міжнародна співпраця



Я. КАЛИВОДА<sup>1</sup>, Л. А. НЕДУЖАЯ<sup>2\*</sup>

<sup>1</sup>Каф. «Автомобілі, двигатели внутреннего сгорания и железнодорожный транспорт», факультет машиностроения, Чешский технический университет, ул. Техническая, 4, Прага 6, Чехия, 16607, тел. + (420) 224 352 493, эл. почта jan.kalivoda@fs.cvut.cz, ORCID 0000-0002-0278-2515

<sup>2</sup>Каф. «Теоретическая и строительная механика», Днепропетровский национальный университет железнодорожного транспорта имени академика В. Лазаряна, ул. Лазаряна, 2, Днепро, Украина, 49010, тел./факс + 38 (056) 373 15 11, эл. почта nlorhen@i.ua, ORCID 0000-0002-7038-3006

## ПОВЫШЕНИЕ УРОВНЯ ИНЖЕНЕРНОЙ ПОДГОТОВКИ СПЕЦИАЛИСТОВ ЖЕЛЕЗНОДОРОЖНОГО ТРАНСПОРТА

**Цель.** Обнародование результатов международного научно-технического сотрудничества Днепропетровского национального университета железнодорожного транспорта имени академика В. Лазаряна (ДНУЖТ, Украина) и Чешского технического университета (ЧТУ, Чешская республика) в области инженерной подготовки студентов на базе современных методов развития научных и творческих способностей студентов. **Методика.** Развитие научной мысли и повышение профессионального уровня студентов машиностроительных специальностей технических вузов железнодорожного направления возможно осуществлять различными методами как во время обучения, так и факультативно, во внеучебное время. Одним из методов повышения уровня будущих инженеров есть публичные лекции известных ученых и исследователей из ведущих европейских высших учебных заведений, что дает возможность студентам иметь доступ к передовой научной мысли мирового уровня. **Результаты.** Приведен анализ деятельности ДНУЖТ и ЧТУ по научно-образовательной подготовке студентов. Подчеркнуто, что международное сотрудничество способствует укреплению контактов между университетами, повышает качество обучения студентов, является одним из факторов их профессионального становления, повышения уровня инженерной подготовки специалистов железнодорожного транспорта. Доказано, что ДНУЖТ и ЧТУ достойно выполняют поставленные высшим образованием задачи по подготовке профессиональных кадров, которые смогут эффективно работать в условиях глобального рынка, направленных на повышение качества, эффективности образования. **Научная новизна.** Выполнен анализ результатов эффективности применения современных методов инженерной подготовки студентов технических высших учебных заведений. Расширено представление об основных направлениях международной деятельности в области образования. **Практическая значимость.** Подтверждено, что популяризация современных методов, распространение инженерной мысли среди студенческой молодежи приобрело новое значение и способствует повышению научного уровня инженерной подготовки специалистов железнодорожного транспорта.

*Ключевые слова:* инженерная подготовка студентов; популяризация научных знаний; международное сотрудничество

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