TÍTULO: Habilidades de comunicación como parte de las competencias universales de los ingenieros de transporte.

AUTORES:

1. Izabella D. Belonovskaya.

2. Dmitry A. Kiryakov.

3. Alexander E. Shukhman.

4. Vadim V. Kolga.

5. Tatjana V. Ezhova.

RESUMEN. En el artículo, las habilidades de infocomunicación se consideran parte de la competencia digital. Se estudia la estructura de la competencia digital y ofrecemos tecnologías innovadoras que forman habilidades de infocomunicación, tales como la gamificación, los cursos en línea, los proyectos en equipo, las interacciones virtuales en red, y las prácticas de infocomunicación orientadas a profesionales.

PALABRAS CLAVES: Habilidades de infocomunicación, competencia digital, formación de ingenieros de transporte.

TITLE: Infocommunication skills as part of Universal Competencies of Transport Engineers.

AUTHORS:

1. Izabella D. Belonovskaya.

2. Dmitry A. Kiryakov.

3. Alexander E. Shukhman.

4. Vadim V. Kolga.

5. Tatjana V. Ezhova.

ABSTRACT: In the article, infocommunication skills are considered part of digital competence. The structure of digital competence is studied and we offer innovative technologies that shape infocommunication skills, such as gamification, online courses, team projects, virtual network interactions, and information-oriented practices for professionals.

KEY WORDS: Infocommunication skills, digital competence, transport engineer training.

INTRODUCTION.

The activity of transport engineers is closely related to the use of infocommunications. Their work includes the information service of high-speed geographically distributed streams using hardware and technological support (Yumatov et al., 2017; Wang et al., 2018). In addition, dynamic professional communication with employees of various transport services is necessary (Zaitseva et al., 2017). The volume of traffic, the complexity of the equipment and the corresponding information systems is constantly increasing. Thus, there is a need to create effective tools and technologies that ensure the formation of infocommunication skills of future transport engineers.

The formation of infocommunication skills should be reflected in the characteristics of the competencies of the graduate, in the educational content, educational technologies, in various resources of the educational program of the university. Infocommunication skills of transport

engineers should be considered as part of their competencies and as a goal of using educational technologies.

From the standpoint of structuring competencies of graduates, infocommunication skills of transport engineers can be divided into two types. Some of them belong to universal competencies, others to professional ones. This division determines the educational organization's capabilities in their formation (Mironova et al., 2017; Prokofieva et al., 2018). Thus, traditionally, universal competences are formed in the cycle of humanitarian, natural sciences and general courses. The cycle of special courses of educational programs is focused on the formation of professional competencies, narrowly aimed at meeting the requirements of professional standards.

The modern recommendations for the modernization of engineering education are called CDIO (Conceive, Design, Implement, Operate) (Crawley et al, 2013). The innovations in CDIO embed in the learning environment as an integral part. The education program should provide for at least two opportunities: to gain experience of designing and implementation activities which develop the skills in designing the products, the processes and systems as well as the ability to apply knowledge in practice. The expertise can be achieved in terms of the graduation projects, apprenticeship and internship.
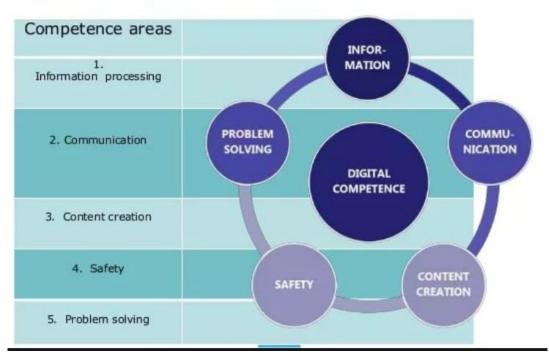
The analysis of publications (Belonovskaya & Shukhman, 2014; The European Commission's science and knowledge service, 2018; Stukalova et al., 2018) made it possible to determine infocommunication skills as a professional personal quality in the conditions of the information society, which reflects as a set of ways of using information media and infocommunication technologies in professional or educational activities.

DEVELOPMENT.

Infocommunication skills as part of digital competence.

Infocommunication skills are currently considered as part of general digital competence (The European Commission's science and knowledge service, 2018). In accordance with the research within the project "TUNING educational structures in Europe", the structure of digital competence includes the following elements: information processing, information communication, content creation, information safety, problem solving in the field of information (Fig.1).

Figure 1. The structure of the digital competence of the engineer.

The competence in the field of information processes is characterized by the ability to articulate information needs, collect, process, store, transfer and distribute digital data and information.

The competence of communication is characterized by the skills of cooperation through digital technologies with a clear understanding of the features of intercultural communication, a variety of approaches to communication among different participants of interaction.

The competence in creating digital content is determined by the ability to create and edit digital materials, improve and integrate information and content into an existing body of knowledge, understand and create understandable instructions for a computer system, acting as a writer.

Safety competencies are determined by the ability to protect devices, content, personal data and privacy in digital environments. Competence implies knowledge of the environmental impact of digital technologies, the risks of their use.

The competence of solving problems is determined by personal and professional resources for identifying, posing and solving conceptual problems, presenting the problem in the form of a set of problem situations in digital environments.

The analysis of the presented structure allows us to consider infocommunication skills as a part of universal information competence, which characterizes the integrative readiness of the person to use modern information technologies and to communicate in information environment.

Innovative technologies forming infocommunication skills.

Innovative technologies forming infocommunication skills are gamification, online courses, team projects, network virtual interactions, professional-oriented infocommunication practices (Davoudi et al., 2018; Fartash et al., 2018; Tastan et al., 2018; Chahine, 2018). Gamification is a technology that implements the use of gaming techniques in an educational or professionally-oriented non-game context (Garris, Ahlers & Driskell, 2002; Aransky & Klarin, 1987; Ellington, Addinal & Percival, 1981; Guzdial, Rick & Kehoe, 2001; Verbitsky, 1991). For training future transport engineers, infocommunication skills are formed within the business simulation game process, in which the student is assigned the role of either the employee of the transport company or the consumer of its services. As a rule, the game scenario is built on typical problem situations. Such situations include keeping business records, adapting to new labor functions, solving logistic tasks, preventing and eliminating transport accidents.

The practice of using business simulation games has shown that their effectiveness will be ensured when certain requirements are met. First, students are given only those roles that correspond to their future positions. This requirement allows you to optimize the training time, not to spend it for the development of useless skills. Thus, the business game "Development of routes and schedules of road transport using the criterion of the minimum cost of delivery" is aimed at developing the infocommunication skills necessary for managing transport. The roles of logistics managers are played but the roles of vehicle drivers and shop owners are not used.

The second condition is the presence of virtual interactions that are aimed at the development of infocommunication skills. These include the ability to negotiate using a variety of communications and telecommunications. The peculiarity of such negotiations is the lack of visual contacts, high speed of interchange of information, its brevity and lack of certainty; for example, in the business game "Operational Organization of Production at a Motor Transport Enterprise and in its Branches", a student must ensure interaction with services in remote territories using unstable mobile communications. Teams compete in the speed of technical information messages, in the ability to recognize reliable and unreliable information, to transmit the received information in a minimized, undistorted or edited form to another player.

The third condition is to use professional content for a business game. So, for example, in the business game "Traffic collapse on the winter highway" a scenario, explanations of the situation on the road, characteristics of road users and players, explanations of role descriptions are presented using professional terminology.

Online courses are open electronic resources for interactive acquisition of the necessary information and communication skills. Online courses include training and test content, which ensures the interest of students in the content and forms of education, and their relevance to the actual tasks of transport engineering. Online courses also are used as elements of an adaptive personalized educational

environment (Wilson et al., 2017). In (Lers et al., 2017) authors offer six indicators that determine the adaptability in the MOOC:

1. Course content / activities are available depending on the choice of students or on the results of previously evaluated events.

2. Course content / activities are available depending on the student's working speed. There is no fixed schedule for accessing content, and all content is not offered at the same time.

3. The student can choose between different levels of difficulty in the content / activities to achieve different learning objectives.

4. Students are organized on the same area of interest / same experience / same level of experience, for discussion in specific forums.

5. Participants can choose between different assessment methods (self-assessment, peer assessment, etc.).

6. The need for peer assessment is also organized according to area of interest / experience / level of experience.

Team projects are based on Product Lifecycle Management (PLM) technology. An important feature of engineering teams is changing roles and functions of each member that provide the ability to replace a team member due to new circumstances to perform tasks in new conditions.

In this regard, engineers must have interdisciplinary skills and knowledge in various areas of production. All the skills can be presented as so-called "T-shaped skills" of an engineer (Karjalainen, Koria & Salimäki, 2009). Fig. 2 provides a diagram of such skills.
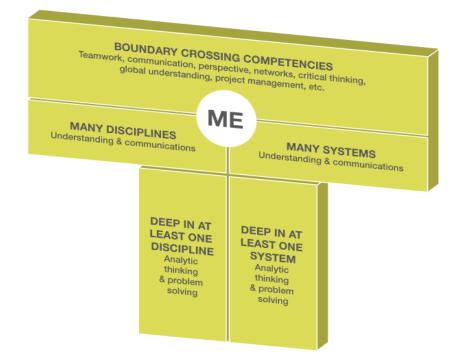
Figure 2. "T-shaped skills" of an engineer.

The concept of "T-shaped skills" is a visual representation of the depth and breadth of knowledge. The base of the letter "T" denotes the depth of skills and experience in a particular field, and the upper bar indicates the breadth of skills and opportunities to work together in various disciplines with experts in other fields and apply knowledge in other areas. For engineers, this means not only the presence of deep technical knowledge, but also the presence of communication skills, team rallying skills, interpersonal skills. For future engineers, the development of "T-shaped" skills can be a decisive factor for a successful career after graduation.

The implementation of project technologies has several limitations. First of all, the training and real goals of the project are established. Then the expected result is determined for training and / or for the practice of transport industry. The following restrictions are the scope and timing of the project work, as well as the possible composition of the design team. An important condition is to determine the type of the design decision and the form of its presentation. The formation of infocommunication

skills involves the use of computer-aided design systems, geo-information technologies, network technologies, presentations, and teleconferences in projects.

Network virtual interactions are based on the use of CALS technology which create opportunities for global interaction of engineers from different cities and countries. Interaction acquires new qualities using 3D visualization technology and Virtual Reality & Global Visual Collaboration. They create "presence effects" based on computer technologies of visualization, virtual reality, simulation of realistic behavior and are intended to ensure global cooperation between geographically dispersed and interacting teams of engineers.

Infocommunication skills are formed in the process of project implementation. Initially, a design object view is created using visual representations. For example, the design object may be a traffic pattern for urban routes. Then a transport network model is developed, optimization criteria are evaluated, and visualization of transport and passenger flows is used (Fig. 3).

Figure 3. A map of transport and passenger flows.

Infocommunication practices involve the use of actual automated systems and various infocommunication tools used in transport industry for organizing professionally-oriented interaction. Students on technological practices at enterprises use electronic document management systems, CRM systems for transport industry, work in training mode with enterprise databases, where all the operations with trains, wagons and containers are displayed in real time.

In addition to planning the movement of vehicles, there is a demand for real-time monitoring of vehicles and cargoes, which can detect deviations from the schedule, take measures to eliminate them, predict delivery times and inform customers. Such systems are based on GIS and use the database that collect data from GPS receivers. GIS also are used to display coordinate information in a geographic context. Also, to monitor the movement of transport used unmanned aircraft. Students master complex dispatching skills using modern infocommunications.
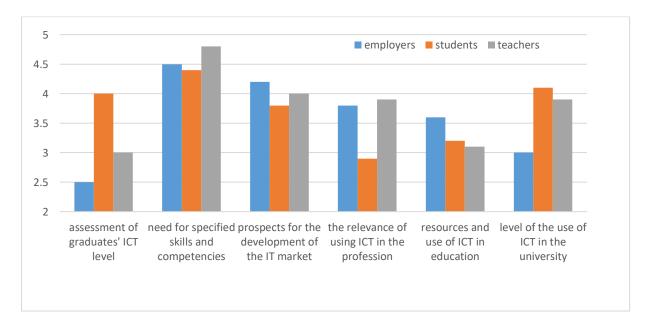
Figure 4. Assessment of infocommunication skills by employers, students and teachers.

Results of a survey to establish requirements for the infocommunication skills.

As a pilot project to establish requirements for the infocommunication skills of transport engineers, a survey of employers, students and teachers was conducted.

The group of employers was represented by heads and leading experts of transport enterprises (17 people). The group of teachers included the teachers working in the university's transport department. The group of students included 102 students from various faculties of the Orenburg State University. The questions were grouped into 6 groups: assessment of graduates' level of information and communication technologies, the need for specified skills and competencies, prospects for the development of the IT market, the relevance of using ICT in the profession, resources and use of ICT in the educational process, level of the use of ICT in the educational process of the university. Assessment was performed on a 5-point scale (Fig.4).

It was found that all subjects of the educational process are unanimous in the high importance of ICT in all spheres of life activity of the modern person, as well as the growing importance of the role of ICT in the profession. At the same time, the information and communication competence of students is not sufficiently formed. Taking into account the forecast of the increasingly widespread use of ICT in all areas of activity of university graduates, the need to develop ICT in the educational process, as well as providing additional measures in this direction, is noted.

Results of a survey to establish the level of the Infocommunication Skills of graduates.

The next stage of our research was aimed at establishing the level of formation of the infocommunication skills of graduate transport engineers (Fig.5). The list of skills was determined on the basis of the study of job descriptions, professional standards in the field of transport and the questionnaire of transport service engineers:

1. Ability to use information on the implementation of software and hardware in transport.

2. Possession of software systems for managing transport facilities.

3. Possession of software systems for maintenance of transport objects

4. Ability to apply information and control systems associated with the introduction of new equipment, its repair, modernization.

5. Skills of using radio and mobile communication.

6. Skills of using information-analytical systems for organizing activities of transport workers.

7. Ability to collect, sort, analyze and distribute information in the implementation of automated control systems.
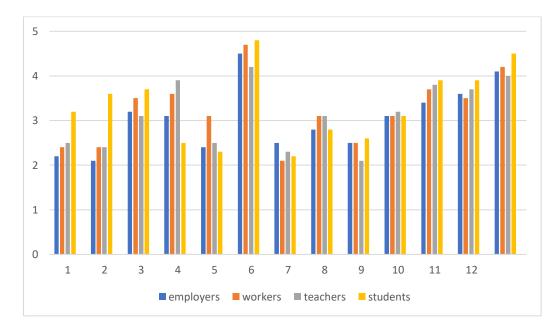
8. Ability to choose the best ways when introducing new software products to transport.
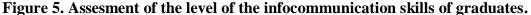
9. Ability to apply methods of searching, storing, processing, analyzing and presenting information from various sources and databases.

10. Skills using digital communication channels.

11. Ability to use Internet communications.

12. Skills to use network information technologies

13. Skills of providing basic requirements of information security.

Figure 5. Assesment of the level of the infocommunication skills of graduates.

The analysis of the results showed that employers are critical of the preparedness of students in the field of professional infocommunication, the average score is no more than 3. The heads of students' practice assess the formation of skills of graduates of higher education institutions somewhat higher

(3.2). The position of teachers who estimated the overall level of training on average at 3.1 is close to these estimates. It should be noted that the students themselves assessed their skills in the infosphere low (3.2). Such a convergence of results is explained by the fact that right now there is an intensive modernization of education in this area.

Results of an assessment of infocommunication skills.

The assessment of infocommunication skills is carried out based on specially developed complexes of infocommunication tasks including searching and evaluating information, organizing interaction with colleagues, creating online resources on a given topic, and participating in transport projects using modern infocommunication technologies.

Innovative technologies forming infocommunication skills were implemented to experimental groups of students in the conditions of the Orenburg University and the Orenburg Institute of Communications. The experimental activity was attended by students of 2-4 courses (Table 1). The evaluation was conducted by teachers on a 5-point scale. The average scores in the group were determined.

The average score in the experimental groups had been 3.07 before the experiment; after the experiment in the experimental groups the average score was 4.3.

Table 1. Average Score for Experimental Student's Groups.

Innovative Technologies to Form of Infocommunication Skills.	Average Score.	
	Before Training.	**After Training.**
Gamification (17 students).	3.11	3.91
Online Courses (57 students).	3.07	3.95
Team Projects (21 students).	3.02	4.54
Network Virtual Interactions (15 students).	3.04	4.41
Infocommunication Practices (11 students).	3.01	4.71
Average Score.	3.07	4.3

Thus, modern pedagogical technologies are effective factors in the formation of infocommunication skills of future transport engineers. The greatest influence on increasing the level of formation of such skills is provided by infocommunication practices at the same time there are positive effects of using professionally-oriented business games, online courses, team projects and network virtual interactions.

CONCLUSIONS.

We determine infocommunication skills as a set of ways of using information media and infocommunication technologies in professional or educational activities; also, infocommunication skills as a part of universal information competence, which characterizes the integrative readiness of the person to use modern information technologies and to communicate in information environment. We offer innovative technologies forming infocommunication skills such as gamification, online courses, team projects, network virtual interactions, professional-oriented infocommunication practices.

We develop the list of infocommunication skills for transport engineers on the basis of the study of job descriptions, professional standards and the questionnaire of transport service engineers.

Innovative technologies forming infocommunication skills were implemented to experimental groups of students in the conditions of the Orenburg University and the Orenburg Institute of Communications.

The use of innovative technologies in the training of students has significantly increased the average score in the experimental groups.

BIBLIOGRAPHIC REFERENCES.

1. Aransky, V. S., & Klarin, M. V. (1987). Modern teaching: The strategy of the didactic game in the teaching process. International Review of Education, 33(3), 312-315.

2. Belonovskaya, I. D., & Shukhman, A. E. (2014). The Methodology of Complex Continuous Training of the Students of Technical Universities to Innovative Activities. Mediterranean Journal of Social Sciences, 6(2), 36-42.

3. Chahine, I. C. (2018). Exposing the Conscious Self: Lived Problem Solving Experience in a Socio-Cultural Context. International Electronic Journal of Mathematics Education, 13(3), 221-231. https://doi.org/10.12973/iejme/3880

4. Crawley, E. F., Edström, K., & Stanko, T. (2013). "Educating engineers for research-based innovation – creating the learning outcomes framework", Proceedings of the 9th International CDIO Conference. Cambridge: Cambridge Massachusetts.

5. Davoudi, S. M. M., Fartash, K., Venera, G. Z., Asiya, M. B., Rashad, A. K., Anna, V. B., & Zhanna, M. S. (2018). Testing the Mediating Role of Open Innovation on the Relationship between Intellectual Property Rights and Organizational Performance: A Case of Science and Technology Park. EURASIA Journal of Mathematics Science and Technology Education, 14(4), 1359-1369.

6. Ellington, H. J., Addinal, E., & Percival, F. (1981). Games and simulations in science education. New Yorl: Routlrdge.

7. Fartash, K., Davoudi, S., Baklashova, T., Svechnikova, N., Nikolaeva, Y., Grimalskaya, S., & Beloborodova, A. (2018). The Impact of Technology Acquisition & Exploitation on Organizational Innovation and. Eurasia Journal of Mathematics, Science and Technology Education, 14(4), 1497-1507.

8. Garris, R., Ahlers, R., & Driskell, J. E. (2002). Games, motivation, and learning: A research and practice model. Simulation & gaming, 33(4), 441-467.

9. Guzdial, M., Rick, J., & Kehoe, C. (2001). Beyond adoption to invention: Teacher-created collaborative activities in higher education. The Journal of the Learning Sciences, 10(3), 265-279.

10. Karjalainen, T. M., Koria, M., & Salimäki, M. (2009). Educating T-shaped design, business and engineering professionals. In Proceedings of the 19th CIRP Design Conference–Competitive Design. Cranfield University Press.

11. Lers, D., Sein-Echaluce, M. L., Hernández, M., & Bueno, C. (2017). Validation of indicators for implementing an adaptive platform for MOOCs. Computers in Human Behavior, 72, 783-795.

12. Mironova, M. D., Zaitseva, N. A., Larionova, A. A., Novikov, A. I., & Borisova, A. A. (2017). The formation of key competencies of employees of the enterprises of service sphere, applying innovative management techniques. International Journal of Advanced Biotechnology and Research, 8(2), 660-666.

13. Prokofieva, E. N., Erdyneyeva, K. G., Galushkin, A. A., Prokopyev, A. I., Prasolov, V. I., Ashmarina, S. I., ... & Kubiatko, M. (2018). Risk based ecological economics to engineering students. EURASIA Journal of Mathematics Science and Technology Education, 14(3), 753-764.

14. Stukalova, O. V., Zatsepina, M. B., Prokopyev, A. I., Gaidamashko, I. V., Kiryakov, D. A., & Dementieva, Y. V. (2018). Potential of Information and Communication Environment in the Process of Student Creative Self-Realization. Astra Salvensis, 2, 415 – 423.

15. Taştan, S. B., Davoudi, S. M. M., Masalimova, A. R., Bersanov, A. S., Kurbanov, R. A., Boiarchuk, A. V., & Pavlushin, A. A. (2018). The Impacts of Teacher's Efficacy and Motivation on Student's Academic Achievement in Science Education among Secondary and High School Students. EURASIA Journal of Mathematics, Science and Technology Education, 14(6), 2353-2366.

16. The European Commission's science and knowledge service. (2018). URL: https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework

17. Verbitsky, A. A. (1991). Contextual learning technologies in the system of continuous professional education. International Journal of Continuing Engineering Education and Life Long Learning, 1(3), 263-268.

18. Wang, Z., Utemov, V. V., Krivonozhkina, E. G., Liu, G., & Galushkin, A. A. (2017). Pedagogical Readiness of Mathematics Teachers to Implement Innovative Forms of Educational Activities. Eurasia Journal of Mathematics, Science and Technology Education, 14(1), 543-552.

19. Wilson, S., Liber, O., Johnson, M., Beauvoir, P., Sharples, P., & Milligan, C. (2007). Personal Learning Environments: Challenging the dominant design of educational systems. Journal of E-learning and Knowledge Society, 3(2), 27-38.

20. Yumatov, K. V., Kiriyanova, L. G., Yakimova, N. S., Zaitseva, N. A., Larionova, A. A., & Korsunova, N. M. (2017). Problem-Based Learning Methods for Training Staff for Tourism and Hospitality Clusters. Eurasian Journal of Analytical Chemistry, 12(5b), 803-812.

21. Zaitseva, N. A., Larionova, A. A., Yakimova, N. S., Leukhova, M. G., & Radina, O. I. (2017). Methodological aspects of foreign language teaching in the preparation of the tour guides. Modern Journal of Language Teaching Methods, 7(4), 399-409.

DATA OF THE AUTHORS.

1. **Izabella D. Belonovskaya**. Department of Technology of Mechanical Engineering, Metalworking Machines and Complexes, Orenburg State University, Orenburg, Russia. E-mail: t251589@mail.ru

2. **Dmitry A. Kiryakov.** Department of Information Technologies, Orenburg Institute of Means of Communication (branch), Samara State University of Means of Communication, Orenburg, Russia. E-mail: aida.osu@gmail.com

3. **Alexander E. Shukhman.** Department of Geometry and Computer Sciences, Orenburg State University, Orenburg, Russia. E-mail: shukhman@gmail.com

4. **Chahine, I. C.** (2018). Exposing the Conscious Self: Lived Problem Solving Experience in a Socio-Cultural Context. International Electronic Journal of Mathematics Education, 13(3), 221-231. https://doi.org/10.12973/iejme/3880

5. **Vadim V. Kolga.** Department of Aircraft, Siberian State University of Science and Technology named after M.F. Reshetnev, Krasnoyarsk, Russia. E-mail: kolgavv@yandex.ru

6. **Tatjana V. Ezhova.**Department of Foreign Languages, Orenburg State Pedagogical University, Orenburg, Russia. E-mail: ortatmin@mail.ru