

Benefits and drawbacks of the national and foreign engineering education. Development trends

N.A. Voronova, M.S.Ostapenko

Institute of Industrial Technologies and Engineering, Industrial University of Tyumen, Tyumen, Russia

Abstract: Modern education is a factor that determines the development of a person not only as a personality, but also as a well-qualified specialist. The change in the vector of development of state educational standards of higher education contributes to the reform of programs and methods of teaching students. The integration of the educational environment has led to the fact that most countries have adopted the Bologna system of education. It is thus losing the individuality of the educational process. This paper presents the differences between the national and foreign models of education, as well as the general requirements currently imposed on the quality of engineering education. The study was conducted based on a survey among students, teachers, and employees of enterprises. The aim was to determine the level of engineering education, the number of specialists, as well as personal and professional qualities of future employees of enterprises. The results of this research are based on respondents' responses to an online questionnaire. The paper proposes the reconstruction of engineering education based on the scientific research and the authors' personal opinion, which contributed to the internationalization of science and the creation of international departments, increased mobility, language training, as well as the creation of conditions for non-standard tasks and team-work. The possibility of training students in real projects, which will promote the relationship between universities and enterprises, as well as facilitate the adaptation of students in the workplace in the future, was considered.

1 Introduction

Higher education is considered a critical factor and essential for the future success of people in modern society [1]. Nowadays, enterprises search for a skilled workforce oriented towards intellectual work and able to embrace high technologies, who will also develop these technologies and implement them in industries. That is why training of well-trained professionals for enterprises and the development of engineering education are policy challenges and priority growth areas for the country's development.

In the 21st century, people who have definite achievements in their scope of activity and who can use their knowledge and abilities for actual problem solving are deemed to be

highly trained professionals. Most highly trained professionals are employed indefinite scopes of expertise and have a narrow specialization.

Tatyanenko notes that Russian society has historically been positive towards engineering education, and most of the engineering schools recognized by the world community are successfully operating [2], thereby confirming the potential of Russian engineering education. In the last decade, the programs, norms, and standards of the academic establishment have been undergoing significant changes. All changes and innovations are implemented to improve the quality of education. In her work, Gorshkova [3] notes that a modern engineer must be a researcher, as the originality and nature of engineering activities are directed at the features of modern production. This point of view, which is that the modern and future engineer should be perceived as a researcher, allows turning engineering education to the sphere of mastering the methods of research activity and thereby radically changes the idea of engineering universities.

In his work, Mikhail N. [4] indicates that currently higher education is aimed at the formation of educated people who will have all the necessary competencies to fight in the modern labour market. This accurately describes the current state of the contemporary education environment since it is a competitive approach that contributes to the education of a sought-after engineer.

The novelty of this research lies in the fact that the present education system, or rather the Bologna education system, is undergoing changes that are fixed in the federal educational standards (FES) that are mandatory.

2 Survey

To define further development of modern education, we offered students to complete a survey which included three questions:

1. What is the level of engineering education nowadays?
2. Who is the main requestor of qualified engineers?
3. What personal qualities and professional strengths should an engineer should have?

A questionnaire, an empirical method, was used to collect data. The survey was conducted in the form of an anonymous survey. There was one mandatory open question: the place of work or study.

509 people took part in the survey, including:

- Students getting bachelor and master's degrees, 176 respondents
- Faculty members of three universities (Industrial University of Tyumen, Tyumen State University, and UPI named after the first President of Russia B. N. Yeltsin), 174 respondents
- Enterprise employees (PAO Lukoil, PAO Surgutneftegas, PAO Gazprom Neft, Tyumen Battery Plant, PAO Tyumen Motor Builders), who are not only in demand in the Tyumen Region but also actively cooperate with universities, 159 respondents.

These groups of respondents were selected based on the following factors:

- Students, as future employees of enterprises, should understand what requirements the employer imposes for further successful employment
- Faculty members, as well as students, should be aware that organizations hire qualified personnel
- Enterprises must submit the requirements that the graduate will have to meet after getting a bachelor's or master's degree program.

The survey results presented in Figures 1-3 were obtained.

One of the main questions asked to the respondents was about the level of engineering education at present. The results on this question are presented in Figure 1. The data are presented as a composition in percent.

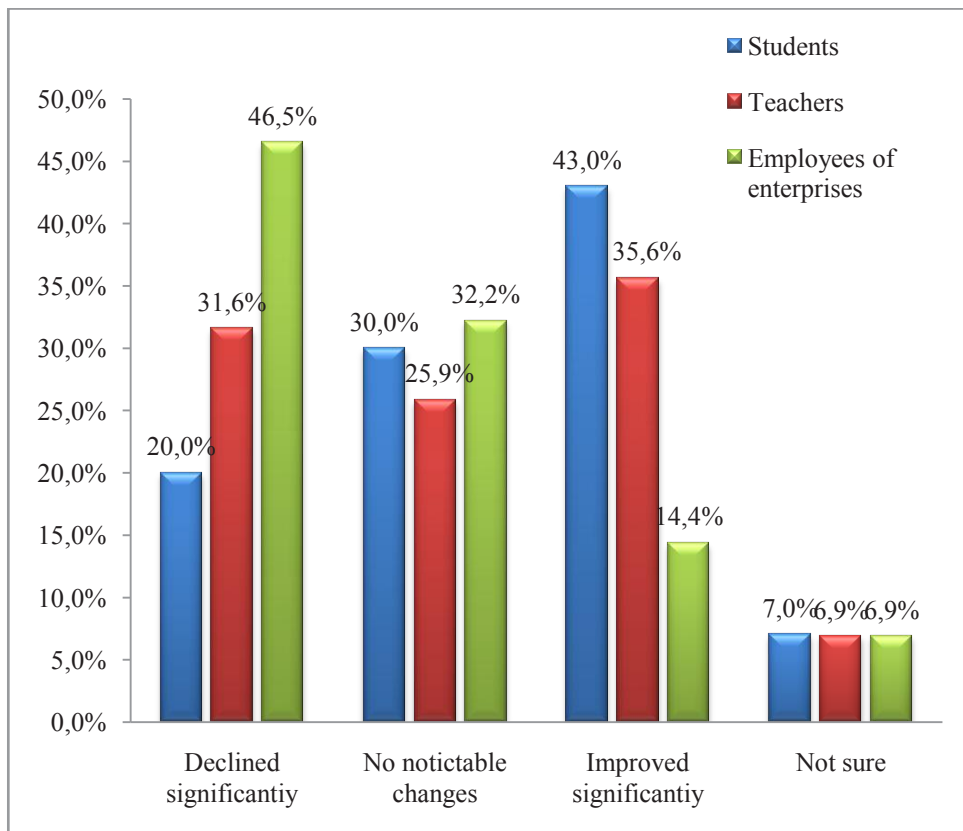


Fig.1. Level of engineering education.

Figure 1 show that the level of engineering education at present, according to employees of enterprises (46.5 %), has deteriorated, as evidenced by the results of the survey. This opinion is also supported by 31.6% of faculty members. Only 20% of students studying in undergraduate and graduate programs report a decline in the level of education.

Based on the answers companies’ employees, wet can conclude that modern graduates are not ready to face the real problems of enterprises. Students lack practical skills that would contribute to the adaptation process in the workplace.

The question: “Who is the main requestor of qualified engineers?” was meant for a free answer.

Having analyzed the answers of the students who took part in the survey, we concluded that nowadays the state is the main requestor of qualified specialists. It should be emphasized that due to the change of organizational and legal form, the individual entrepreneur - the organizer of the production process acts as an employer.

The last question posed to respondents was about personal and professional qualities that, according to the survey participants, are in demand in the labourmarket today.

The personal qualities picked by respondents are presented in Fig. 2.

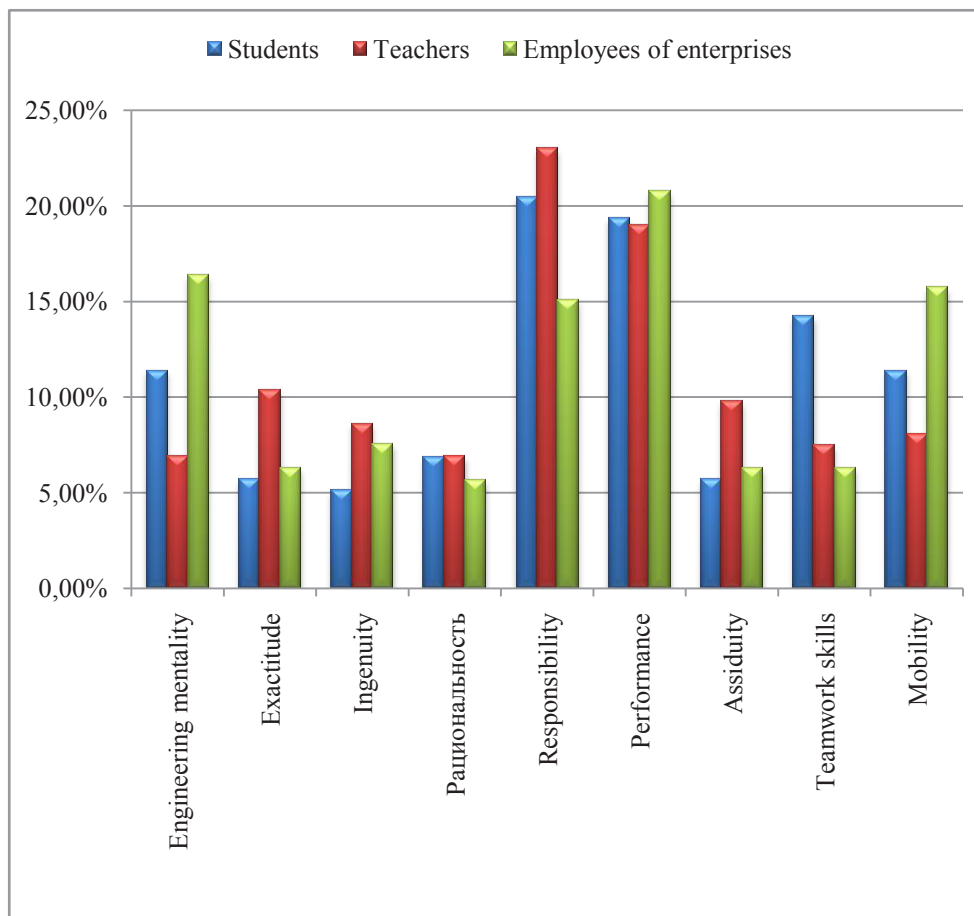


Fig. 2. Personal qualities

It is important to note that the selected personal qualities of students are based on the individual (subjective) opinions of respondents.

Based on the FES, the professional qualities that an engineer should have were identified. A list of professional strengths that a modern engineer should have is presented in Fig.3

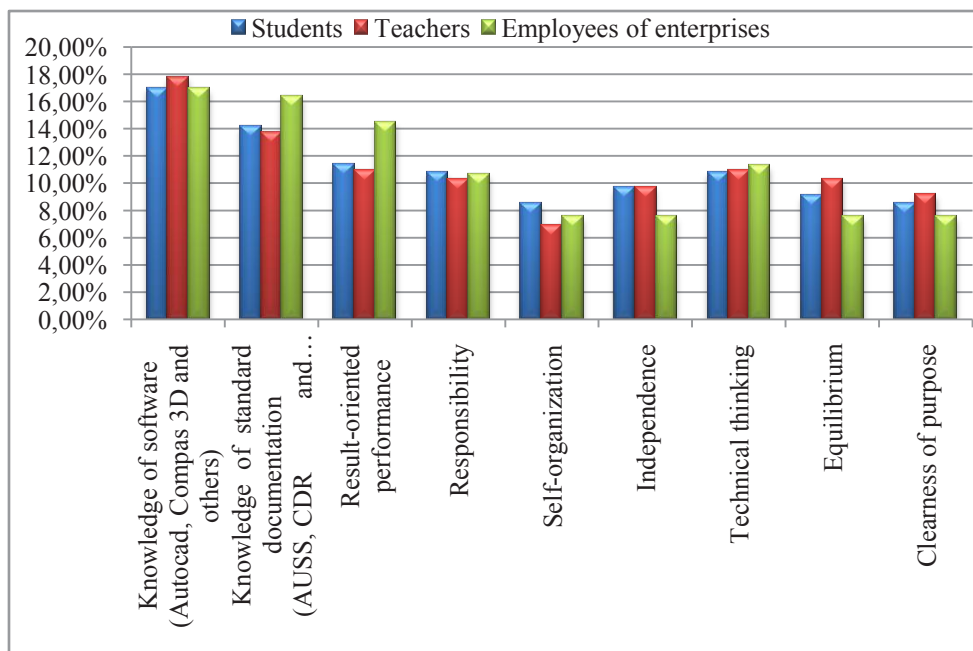


Fig. 3. Professional strengths.

It follows from Fig. 3 that nowadays students pick out four essential qualities that a well-qualified engineer should have:

- Knowledge of the software (Autocad, Compas 3D, and others)
- Technical thinking
- Knowledge of standard documentation (AUSS, CDR, and others)
- Professional responsibility.

The diagram also shows that employees of enterprises distinguish “Results Orientation” since this quality is one of the most important when solving problems in practice.

According to the respondents, if a specialist has personal qualities and professional strengths which are presented in Figures 2 and 3, then he/she will be in demand on the job market. But also worth mentioning is that the professional strengths and personal qualities of university students do not always correspond to the requirements of future employers.

This survey has shown that if the level of engineering training, the development of professional strengths and personal qualities required for work in different areas, as well as cooperation with customers - employers, universities can train future engineers who will be in demand on the job market.

When answering these questions, we picked out several necessary changes in engineering education in several spheres: internationalisation of science and creation of international departments, enhancement of mobility, language proficiency, and also the conditions for solving non-standard tasks and teamwork.

1. Domestic and foreign education

The following is an analysis of the literature related to the two educational environments: domestic and foreign (Bologna system). This analysis allowed us to identify not only the positive and negative aspects of educational systems but also the possibilities of remodeling of engineering education.

The systems of education throughout the world are undergoing reform due to global changes in society, the transformation of political systems, and other socio-economic factors [5].

During an analysis of the two education systems, we picked out the benefits and drawbacks of the national and foreign education systems, which are presented in Table 1.

Table 1. Benefits and drawbacks of the national and foreign (Bologna) education systems

National education system		Bologna education system	
Benefits	Drawbacks	Benefits	Drawbacks
Generality and availability	Brain drain and other losses of academic staff under the influence of ideology and political fight	Enhancement of the level and allure and availability of European higher education	General mess including the mess in academic programs during the period of connecting to the process
Access to education for all racial and linguistic minorities	Low quality of foreign language teaching.	The orientation of degrees and qualifications, given by universities, to the job market	Risks of losses of educational experience in the history of national higher education
High level of training. High quality of higher engineering education	Blackening of pre-soviet historical period, deformation of moral guides	High level of students and lecturing staff. Activation of international exchanges between universities	Practical incapability of some innovations of the process
Satisfying the requirements of a state for a new labour force when there was a sharp rise of industry, creation of new spheres, appearance of new engineering spheres.	Doubtful quality of liberal education because of the ideological bent	Opportunities for universities to take part in projects sponsored by European institutions	Decrease of higher education level because of the orientation on a narrowly focused specialist in the prejudice of fundamental training which develops analytical and critical thinking

As shown in Table 1, generality was the uppermost achievement of national education, which helped to achieve almost universal literacy for the first time in the history of Russia. Also, it is worth mentioning that job placement was ensured to all graduates of universities because the demand of the state for qualified specialists was very high.

Having analyzed the national system of education, we concluded that the USSR created one of the best education systems, and due to that the Soviet education pattern rated high not only at home but also abroad.

At the end of the last millennium, European ministers in charge of higher education initialized a set of far-reaching reforms that are known as the Bologna Process. Today, 48 countries participate in this endeavor, which has harmonized higher education systems across Europe, to enhance the competitiveness, mobility, and employability of their students [6].

The development of modern society has led to Russia's transition to the Bologna education system since 2003. As a result, Russia has reached a new level and continued to compete in the market of educational services.

The Bologna education system implements such goals as:

- Expanded access to higher education;
- Enhancement of not only the quality of training but also of students and teachers mobility;

➤ Guarantee of successful job placement of university graduates [7].

But as a national pattern of training, the Bologna system has benefits and drawbacks presented in table 1. One of Bologna system's benefits is that this system is oriented on that students get a set of skills present on the real job market.

From all that has been said, it follows that the USSR created one of the best educational systems, which was gradually replaced the Bologna educational system. Bologna which allowed importing new components to higher education, such as:

- Orientation on the real jobmarket;
- Mobility of students;
- Use of innovative educational methods.

The transition from the Soviet educational system to the foreign one (Bologna model) contributed to: the attraction of new cohorts (international students), new technologies, and modes of learning.

The Bologna process has already led to the appearance of lots of reforms in the Russian education system, and consequently, it provided a basis for further innovations.

Opportunities for students to develop and actualize real projects or take part in them to get the necessary experience and professional strengths should be the further stage of engineering education development.

One of the tendencies of engineering development is education using real projects. But according to Klochkov [8], "It is not possible to develop a single strategy for all universities; however, having analyzed the programs of universities, we can outline major development directions."

Nowadays, most of universities transfer to project education. Working on real projects promotes the development of professional skills that are in demand on the job market. Also, the project approach encourages the training of staff for the industry.

As a rule, during the six years of education (four-year Bachelor's degree plus two years of the Master's degree), a student has to take part in 4 to 10 real projects and get accurate results [9]. This approach should be used in higher school, but with the involvement of tasks from the industry which are relevant today. Training students with the use of real projects will help a graduate to get a set of skills necessary for further work in a chosen sphere of activity when getting a job. Thanks to this approach to education, there will not be a "gap" that exists today between graduates and enterprises, because when hiring an employer suggests that a graduate forget everything he/she studied at university.

To determine respondents' opinions about education using real projects, we asked a question: "Would you like to take part in real projects during your training at university?" According to the results of the survey, we received data presented in Figure 4.

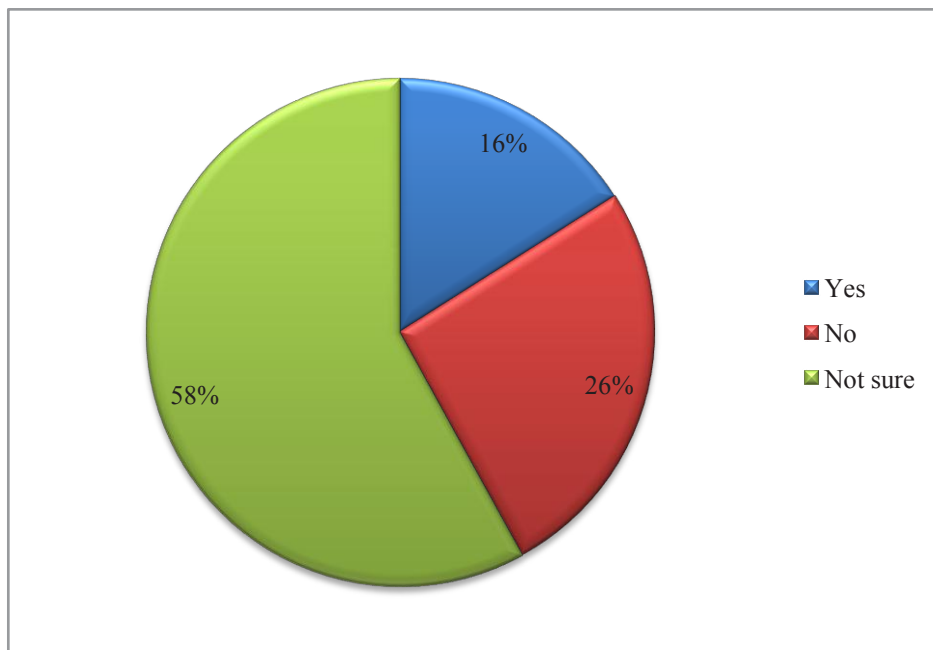


Fig. 4. The answer of respondents to the question “Would you like to take part in real projects during education at the university?”

From Fig. 4 we can see that 58% of respondents have answered in the affirmative, 26% do not want to take part in projects, and 16% are neutral.

Real-world project-based learning will focus the student’s attention not only on analyzing a problem, but also on researching and finding solutions, which will be the initial step in the transition to further education. While studying a problem that exists in industries, students will gain knowledge consciously. Also, using an inter- and multi-disciplinary approach, students will not only gain independent understanding but they will also be able to use and focus it in the process of solving a specific problem.

Also, training based on real projects will promote the creation of a whole chain of “research – design – technology – production – bringing to a consumer – provision of operation,” which a modern graduate should not only use but create on his/her own.

4 Conclusion

The main conclusion that can be made is that the quality of education has improved and this was facilitated not only by the change of the education model but the understanding of students that if they get professional skills, they will be in demand on the job market. As in the USSR, the state is the main customer of well-qualified specialists, and it promotes the development of educational services. The transfer to the Bologna model of education contributed to the development of the Russian education system. It also made it possible to create a new approach to education – engineering education through real projects.

Engineering education using real projects can be considered as an upcoming trend of training because it promotes conduction not only of problem-based research but gives means to solve the tasks set. This approach to training will promote development not only of students but also of industries; it will also sharpen the “gap” between requirements of employers and abilities of graduates because each enterprise will teach and train future workers through projects which exist in industries.

References

1. M. C. Felgueiras, J. S. Rocha, N. Caetano *Engineering education towards sustainability*,(2017)
2. S. A. Tatyanyenko Textbook as a mechanism for managing the cognitive activity of a student. *From innovation to quality of education: a collection of scientific works. Tyumen*, 270-278(2011)
3. O.O. Gorshkova *Features of modern engineering education in Russia*,13-16 (2016)
4. M. N. Dudin, V. V. Bezbakh, E. E. Frolova, M. V. Galkina The Models of Higher Education in Russia and European Countries at the beginning of the XXIst century: the Main Directions of Development,**7(4)**, 653-667(Academic Publishing House Researcher s.r.o., 2018)
5. E. Y. Levina, M. V. Voronina, A.A. Rybolovleva, M. M. Sharafutdinova, L. F. Zhandarova, V. V. Avilova. *The Concepts of Informational Approach to the Management of Higher Education's Development*,11(17), 9913-9922 (LOOK Academic Publishers., 2016)
6. J. J. W. Powell, N.Bernhard, L. Graf The Emergent European Model in Skill Formation: Comparing Higher Education and Vocational Training in the Bologna and Copenhagen Processes. *Sociology of Education 2012*,**85(3)**, 240-258 (2012)
7. N.A.Voronova, M.S.Ostapenko *Comparison of Bologna and soviet educational systems: benefits and draw-backs*, **462**, 15-18(Publishing company: Publishing company "KnoRus" Ltd., 2019)
8. Y. S. Klochkov *Monitoring Centre for Science and Education*, (2016)
9. A.I.Borovkov, S.F.Burdakov, O.I. Klyavin, M.P.Melnikova, V.A.Palmov, E.N. Silina *Modern engineering education*,**80**, 52 (The Publishing House of Polytechnic University, 2012)