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Problems of accessibility of higher engineering education for students with special needs

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Abstract

The article is devoted to studying the problems of accessibility of higher engineering education for people with disabilities and persons with disabilities (PWD), i.e. persons with special learning needs (SLN). Vocational education in modern conditions is becoming a social elevator, giving people with disabilities and disabilities an opportunity for socialization and employment. Studying foreign

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experience reveals the effectiveness of inclusive education. The article describes the current state of inclusive higher education, including engineering, in foreign countries (USA, Austria, Finland, etc.) and Russia. The successful practices of training people with higher education in foreign universities are presented. The characteristic of modern trends in the development of inclusive education in the Russian Federation is fulfilled. The criteria of affordable education in a world practice are highlighted in order to compare and evaluate its effectiveness in the Russian Federation. The advantages and disadvantages of the existing training system for disabled people and people with disabilities in Russian practice are noted. Weak demand for engineering specialties in universities of the Russian Federation was revealed. A study of the causes of this phenomenon.

Keywords: disability, limitation of health opportunities, students with special learning needs, inclusive education, affordable education, higher engineering education.

Problemas de accesibilidad a la educación superior en ingeniería para estudiantes con necesidades especiales

Resumen

El artículo está dedicado a estudiar los problemas de accesibilidad de la educación superior de ingeniería para personas con discapacidades y personas con discapacidades (PWD), es decir, personas con necesidades especiales de aprendizaje (SLN). La educación vocacional en las condiciones modernas se está convirtiendo en un elevador social, dando a las personas con discapacidades y oportunidades una oportunidad de socialización y empleo. Estudiar la experiencia extranjera revela la efectividad de la educación inclusiva. El artículo describe el estado actual de la educación superior inclusiva, incluida la ingeniería, en países

extranjeros (Estados Unidos, Austria, Finlandia, etc.) y Rusia. Se presentan las prácticas exitosas de capacitación de personas con educación superior en universidades extranjeras. Se cumple la característica de las tendencias modernas en el desarrollo de la educación inclusiva en la Federación de Rusia. Los criterios de educación asequible en una práctica mundial se destacan para comparar y evaluar su efectividad en la Federación Rusa. Se señalan las ventajas y desventajas del sistema de formación existente para personas con discapacidad y personas con discapacidad en la práctica rusa. Se reveló una débil demanda de especialidades de ingeniería en universidades de la Federación Rusa. Un estudio de las causas de este fenómeno.

Palabras clave: discapacidad, limitación de oportunidades de salud, estudiantes con necesidades especiales de aprendizaje, educación inclusive, educación asequible, educación superior en ingeniería.

1. INTRODUCTION

The relevance of this topic is evidenced by the fact that disability is a social phenomenon that no society can avoid. According to the World Health Organization, in 2019 there were more than 1 billion people in the world (15% of the world's population) who have some form of disability. The number of people with various types of disabilities is growing every year. The reasons are an aging population and an increase in the number of people suffering from chronic diseases related to disability. Among people with disabilities, approximately 5% are children of various ages, for whom solving educational issues is no less important than maintaining health. Since

vocational education, along with other factors, contributes to their social adaptation, opportunities in the future to independently provide for themselves, create a family and prepare the material basis for improving their own health. Speaking about competitive education in the era of technological progress, first of all, we are talking about technical and engineering specialties, the need for which is growing from year to year (Panfilova et al., 2019).

The purpose of the study is to study the need and consequences of training people with disabilities, assess the accessibility and effectiveness of using the inclusive higher education system abroad and in Russia, analyze the reasons for the low demand for engineering specialties in universities of the Russian Federation, develop recommendations on the application of positive foreign experience in Russian practice. In accordance with the objectives of the study, an analysis of the relevant literature was carried out, the experience of organizing inclusive education in foreign and Russian universities was studied and generalized.

2. LITERATURE REVIEW

The basic document, which provides a systematic description of the concept of disability, highlights the experience of implementing innovative policies and programs that improve the lives of people with disabilities, is the World Report of Disabilities prepared by the World

Health Organization and the World Bank Group (WHO and World Bank, 2011). The report was published in 2011 as part of the implementation of the UN Convention on Human Rights (The Universal Declaration of Human Rights). This document gave impetus to governments, civil society organizations and organizations of persons with disabilities to develop inclusive policies and create an accessible environment for persons with disabilities. The proposed approach was based on the concept of inclusion of persons with disabilities in community life.

Table 1: Causes and possible consequences of isolation of disabled people

Reason	Implications for the disabled
Poor health outcomes	Great vulnerability to secondary pathological conditions, comorbidity and age-related diseases
Low educational achievements.	Unemployment
Low economic activity	Lower employment rates: 44% for disabled people and 75% for non-disabled people
High poverty rate	Food insecurity, health care, housing
Participation restriction	Isolation and dependence of people with disabilities on other people

Barriers to the implementation of the concept identified a complex of interrelated causes and consequences to which they lead (WHO and World Bank, 2011; Panfilova et al., 2020). At the same time, the social inclusion of people with disabilities with limited opportunities to independently engage in society begins precisely in the educational system.

2.1. The practice of inclusive higher education abroad

Consider the practice of higher education abroad (USA, Austria, Finland, France, Germany) (Bumble et al., 2019; Danforth, 2016; Education in Vienna, 2019; Karhu, 2014; Karpushkina and Olkhina, 2016; Kendall, 2018; Stefanovich, 2017; Welzer and Ledinek, 2014). Since there is practically no description of access programs to specialized types of education in the available literature, the general practice of higher education is considered. America is one of the countries in the world with the best conditions for living and studying for students with disabilities and disabilities (Danforth, 2016; Stefanovich, 2017; Welzer and Ledinek, 2014). According to the US Government Accountability Office, higher education is available to 11% of students with disabilities registered in universities. There are two types of educational institutions, the first of which is special educational institutions focused on teaching students with disabilities, such as the Gallaudet University in Washington (training for the deaf and hard of hearing); Landmark College, Vermont (teaching students

with dyslexia, attention deficit disorder, and autism spectrum disorders). The second type of institution is an inclusive educational institution that, along with ordinary students, accepts students with general education opportunities, creating the most comfortable conditions for them. In these universities (the University of Michigan, University of Southern California, Northeastern University, Massachusetts, University of Xavier, Ohio, etc.), people with disabilities feel themselves to be full members of society, for which not only higher education is available, but also participation in campus events, sports competitions and entertainment (Danforth, 2016; Jones and Goble, 2012).

The experience of European countries seems interesting. In particular, Austria, where all higher education institutions have all the conditions for access to education for people with disabilities, including architectural infrastructure adapted for a comfortable life and movement without outside help (Education in Vienna, 2019). Vienna Technical University has a special program of support and adaptation at the university for people in a wheelchair, hearing impaired and visually impaired, as well as the opportunity for them to participate in research projects at any time.

In Finland, active work to improve the accessibility of persons with disabilities to higher education has been carried out since the beginning of 2000. The Ministry of Education and Culture has developed a long-term program (2006-2015) for training people with various types of disabilities “Higher education for all” (Karhu, 2014: 102). The program included activities aimed at supporting people with

disabilities of all ages for lifelong learning, facilitating the gradual effective transfer from one level of education to another, and from education to employment. Much attention was paid to school programs, since it is the schools that are responsible for early childhood education, laying the foundation for education.

All these years, the Ministry of Education and Culture of Finland participated in the implementation of the conventions of the European Union in the field of access to education for people with disabilities (Karhu, 2014: 104). The result of the work was a number of recommendations for universities, namely: the creation of a web directory that included EU standards, a summary of national legislation, study guides, best practices for overcoming barriers for people with disabilities of various nosologies, and tools for assessing learning outcomes. The types of disabilities were classified and specific recommendations were made to support them. The problems of accessibility of persons with disabilities to higher education were identified and practical measures to overcome them were listed.

Especially recognized was the creation in 2006 of the ESOK Network, of which 36 Finnish universities and more than 50 non-governmental organizations became members. ESOK network works as a source of accessible information, providing a web portal as a training operator and intermediary between educators and organizations representing persons with disabilities (Karhu, 2014: 105). The main functions of the Network were: (1) raising awareness of the accessibility of universities by creating Internet portals and the

Facebook forum, (2) managing projects on the accessibility of universities, (3) organizing seminars and workshops for national cooperation, (4) facilitating the organization of international cooperation between individuals with SLN.

ESOK network participated in a number of projects, the most successful of which were (Karhu, 2014: 107): *1) Support for student learning*. The main goal is to create personal learning models based on the individual strengths of each student with SLN using interdisciplinary methods and practical models to support students with reading disabilities in Finnish-Swedish polytechnic and university education. *2) Mental health and coping.* The project aims to improve the educational opportunities of students (under the age of 26) who suffer from depression or other mental disorders. 3) *The collaboration of the ESOK Network and the Finnish Federation of Vision Impaired.* The aim of the project is to provide blind and visually impaired citizens with the status of equal with ordinary citizens, to improve the skills of visually impaired people. The result of the work was the creation of *Celia* - a special library that includes literature in an accessible format for people who cannot read standard printed books

One can cite other achievements in training people with SLN in foreign practice, which lead to their successful socialization and employment (Zablotskaya, 2016: 19). More useful from the point of view of this study is a generalization of positive experience in general.

As part of an integrated approach, the study highlighted two key criteria. *The first criterion is the ability of higher education institutions to teach students with higher education,* which implies the presence in

universities of special programs of admission, training, assessment of learning outcomes and organization of practice - (Boginskaya, 2016; Florian, 2014; Kendall, 2018; Zablotskaya, 2016). To do this, it is necessary: training programs and teaching aids adapted to the psychophysiological characteristics of higher educational institutions for teachers and support staff of universities, since applicants with disabilities and special needs have no benefits in terms of reducing their educational requirements (Zablotskaya, 2016: 10).

The second criterion is the availability of education for students with SLN, which involves the solution of the following issues: payment for educational services; creating a learning infrastructure; the formation of an institution for the coordination of instruction (tutoring and mentoring); the relationship of the training system for PWD with the labor market (Boginskaya, 2016; Jones and Goble, 2012; Karpushkina and Olkhina, 2016).

Today, training in almost all universities is paid. However, in various countries there are various financial support tools that allow you to solve the issues of payment of tuition (benefits, government and private grants, soft loans), scholarship support, ways, sizes and conditions for obtaining various financial benefits, taking into account national specifics at the state, region and University (Boginskaya, 2016; Hardy & Woodcock, 2015; Kendall, 2018; Zablotskaya, 2016).

The creation of a training infrastructure involves the provision of an accessible environment, including technical equipment of the architectural environment, information and analytical support, the

availability of information and communication systems, preventive medicine and health care, legal and psychological consulting (Boginskaya, 2016; Karpushkina and Olkhina, 2016).

The Learning Coordination Service coordinates work and provides information and material support for students with difficulties (selection of educational and financial programs, work with documents, selection of tutors and assistants). The service includes professionals in various fields who are able to develop relevant measures that compensate for the limitations of health (Zablotskaya, 2016: 18). Separate functions can be assigned to various structural units of educational institutions, including volunteers and volunteer students. An important task of the service is the formation of a tolerant attitude towards students with difficulties in the teaching and student environment (Karpushkina and Olkhina, 2016). In addition, universities in several countries (USA, UK, Spain, etc.) have a successful experience in introducing the post of Ombudsman - a specialist responsible for observing the rights of students with SLN during the educational process (Boginskaya, 2016; Zablotskaya, 2016).

There is an interconnection of the training system for people with disabilities with the labor market and employers, which includes specialized information resources to promote professional development and career growth of PWD and a database of potential employers.

Accessibility of higher education in the Russian Federation. The need to study the world experience of affordable education for students with SLN is explained by many factors. One of the most significant is

quantitative: annually more than 3.5 million people are recognized as disabled, including more than 1 million for the first time (Fedorov et al., 2017: 8). The second is the difference in the number of students. While the number of American students with difficulties reaches 110, in European countries - 70 per thousand ordinary students, in Russian universities the proportion of such students during 2008 - 2016. amounted to 0.38% (Bogomolova and Korzhuk, 2017: 203). As part of the monitoring conducted among 827 Russian universities in 2016 by Minin University, the figure was 0.48% (Kashtanova, 2017: 63). There is no reason to believe that today this situation has changed significantly (Eretnova, 2019; Simaeva et al., 2019). The impressive difference between the figures leads to the conclusion that in the Russian Federation there is currently no effective system for training people with SLN. The results obtained after a more thorough study of the issue should be an occasion for reflection by politicians and economists who make strategic decisions in the field of education, as well as scientists who evaluate the functioning of the education system (Medvedeva and Dvurechanskaya, 2016: 77).

In accordance with the data presented in a study of scientists of Immanuel Kant Baltic Federal University in Russia, the policy of isolation in the education of children with difficulties is still strong (Simaeva et al., 2019: 80). This policy has significant support from educational entities (teachers and parents), who support the education system for children with hearing, vision, musculoskeletal, mental retardation and others in institutions with a narrow focus, based on the

differentiation of children by type of defect. Highly qualified specialists, special educational technologies and adapted programs lead to certain successes in such training.

It should be noted the shortcomings of training in specialized institutions: children are in a closed microsocium, are distant from their families and do not interact with ordinary peers, which subsequently leads to social infantilism, communication difficulties, the need for socio-economic adaptation and vocational guidance after graduation. A comparison of the level and quality of competencies of graduates of specialized and mass schools with an inclusive form of education also testifies in favor of the latter (Simaeva et al., 2019: 81).

At the same time, inclusive education is developing in the Russian Federation. The impetus for its development was the ratification by Russia in 2012 of the UN Convention on the Rights of Persons with Disabilities. Under the Convention:

1) amendments were made to national legislation, including the Federal Law on Education in the Russian Federation No. 273-dated 29.12.2012, the Federal Targeted Program for the Development of Education for 2016-2020, the State Program of the Russian Federation "Accessible environment" for 2011-2015 were adopted and etc.;

2) Universities are obliged to provide access and create special conditions for the education of students with disabilities and PWD of any nosology; 3) inclusive education practices have begun to expand; 4) the principles of "barrier-free environment" began to be widely promoted (Bogomolova and Korzhuk, 2017; Kashtanova, 2017; Simaeva et al., 2019).

Inclusive education of people with disabilities and PWD in Russian universities gives positive results. In 2016, 7,306 students with disabilities and PWD were registered (Medvedeva and Dvurechanskaya, 2016: 6). The five leading universities for teaching students with SLN included: Moscow State University for the Humanities and Economics (428 students); Dagestan State University (368 students); Ufa State Petroleum Technical University (333 students); Bauman Moscow State Technical University (BMSTU) (291 students); The Russian Presidential Academy of National Economy and Public Administration (283 students) (Kashtanova, 2017: 63).

Works of Kashtanova SN, Medvedeva EY, Dvurechanskaya ON, Olkhina EA give the data characterizing students with disabilities and PWD in the context of specific nosologies.

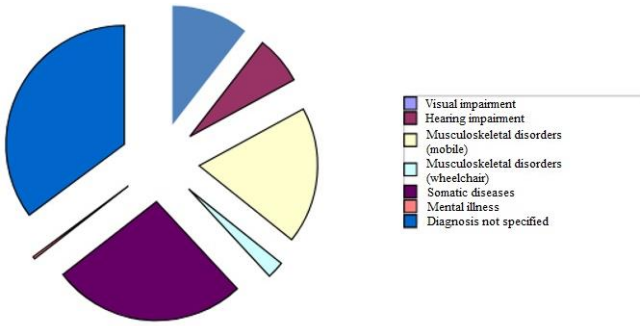

Figure 1: Students with disabilities and PWD in universities of the Russian Federation.

A monitoring slice made on the basis of introspection showed that 10.91% consider themselves fully prepared for training for people with visual, hearing and musculoskeletal impairments, and 26.5% of the universities surveyed consider themselves partially prepared. At the same time, more than 80% of universities do not have the opportunity to provide places to stay in dormitories for students with musculoskeletal, visual and hearing impairments (Kashtanova, 2017: 64).

As mentioned above, the most important characteristics of the availability of education for students with SLN in foreign practice is a high level of financial support, psychological and pedagogical, medical, social and rehabilitation and other types of support. However, only 59.19% of Russian universities carry out additional payments. At the same time, more than half of the students are not covered by any form of escort from the above (Fedorov et al., 2017; Kashtanova, 2017; Olkhina et al., 2016). The interconnection of the education system for people with disabilities and PWD with the labor market and employers is poorly established, which leads to the fact that less than half of these graduates are employed (Damadaeva and Bekhoeva, 2019: 130).

An analysis of the directions of professional education of Russian universities shows: most often people with disabilities and PWD choose pedagogical education (44.03.05 and 44.03.01) - 9.1% of students with disabilities go through it; the economy (38.03.01) is preferred by 8.59% of students, more than 7.03%; the election fell on jurisprudence (03.03.01). Closes the five leading specializations

training in the direction of "Management" (03.03.02) - 4.2% and "Psychologist-teacher" (44.03.02) - 3.55%. It should be noted that in the ten leading areas of training, the specialty “Applied Informatics” (09.03.03) occupies the 9th place, and engineering specialties are absent (Medvedeva and Dvurechanskaya, 2016: 5). The data presented in the areas of study reveal the need to study the causes of low involvement of young people with disabilities in the process of training in engineering specialties in universities.

3. METHODS AND MATERIALS

The research program, conducted from December 2018 to May 2019, included two stages: the first - to identify priority problems of accessibility of higher education for students with SLN; the second - to identify the most significant problems that arise for students with SLN in the process of training in engineering specialties. The study covered 169 state universities in 51 constituent entities of the Russian Federation, where students with disabilities study, including all 48 universities of the Ministry of Culture of the Russian Federation, 46 universities of the Ministry of Health of the Russian Federation and 75 universities of the Ministry of Education and Science of the Russian Federation. At the first stage, 520 first-year students of all specialties and 500 parents of students with disabilities were interviewed. The second stage of the survey covered only first-year students who chose

engineering specialties (more than 100 students), as well as teachers and representatives of the faculty administration involved in the process of their training.

4. RESULTS

As a result of the first stage of the study, factors of accessibility of education in universities of the Russian Federation for students with SLN were identified and an analysis of their significance was performed.

Table 2: Assessment of factors of accessibility / inaccessibility of education in universities of the Russian Federation for students with SLN, in % of the total value

Factors	Estimated factor,%
Information on the possibilities of admitting a person with a disability to a university	15
Awareness of admissions officers on the conditions for admission and training of persons with disabilities	5
Barrier-free environment	14
System of psychological, pedagogical, medical and tutor support	13
Financial support for studies and accommodation	10

Transportation to / from the university	6
Other	37

The study showed that one of the most important factors of accessibility (15%) is the lack of information about the possibilities of admitting a person with a disability to a university. The main source of such information is the sites of universities. However, today they are not fully formed: the version for the visually impaired is on 81% of sites, information about the accessible environment is at 33%, and about special teaching aids is at 31%. The survey showed that the awareness of admissions officers about the conditions for admission and training of persons with disabilities is weak, and no more than 12% of sites have a list of documents required for a disabled person to enter a university.

The importance of the factor of accessibility of buildings and classrooms for the training of people with SLN was indicated by 14% of respondents. At the same time, the problem of architectural accessibility for persons with disabilities, due to insufficient funding and lack of awareness of university administrations, is far from completely solved (Ostapenko et al., 2018; Skamyanova, 2016).

The need for psychological, pedagogical, medical and tutor support was noted by 13% of respondents. However, the system of coordination and support in the educational process is practically absent. Students are practically not involved in the escort work (Ostapenko et al., 2018). Almost one out of ten respondents indicated

the availability of financial support for studying and living as a factor affecting access to education. Since no more than 20% of universities can provide students with SLN places to stay, there is another issue that needs to be addressed - how to get to the place of study and back (6% of respondents).

However, as the study showed, the factor named in the table was named the main limiting factor. 2 “Other”, which is actually not influenced by the university. It is associated with passing a health examination (HE) and obtaining an Individual Program for Rehabilitation and Habilitation (IPRH). The preparation of this document, which includes a set of optimal rehabilitation measures for a person with a disability, is in most cases a laborious process with sufficiently regulated rules (in some commissions the HE required to indicate a specific specialty in the IPRH, as well as a university, where the disabled person plans to go), depriving the disabled person possibilities for further choice. IPRH preparation takes quite a long time (up to 3 months). The results of the second stage are presented in table. 3.

Table 3: The reasons for the low demand for students with SLN engineering specialties, in% of the total value

Reasons	Evaluation, %
Learning availability	20
Availability of adapted distance learning technologies	15

and e-learning systems	
The quality of school training	35
Level of development of intellectual abilities	25
Public stereotype about the loss of prestige of an engineer work	5

Most of the respondents (35%) as the main problem affecting the complexity of training in engineering specialties indicated the lack of school preparation for the requirements of a technical university. A number of authors characterize the situation “as a catastrophic gap between higher and secondary schools” (Yasyukova and Piskun, 2011). Inadequate school preparation, reinforced by any factor of ill health leads to great difficulties in the process of adaptation to the educational process in a technical university.

25% of the responses relate the complication of the process of adaptation of students with SLN to study at a technical university with various shortcomings in the development of their intellectual abilities, the most important of which are engineering (logical, abstract and spatial) thinking. According to Yasyukova LA and Piskuna OE, this aspect of maladaptation manifested itself in connection with the introduction of the Unified State Exercise into Russian practice and a change in the admission system at the university (Yasyukova and Piskun, 2011).

20% of the responses indicated that the problem is the accessibility of the educational process, which is determined by the

availability of adaptive educational programs and special training of teaching staff. It should be noted that there are personnel risks that consist of a shortage of specialists, as well as inconsistencies in the willingness of specialists to perform the functions that are required of them by the system of professional inclusive education.

One of the productive mechanisms for ensuring the accessibility and quality of education for people with difficulties and disability (15% of respondents) is adapted distance learning. According to the results of expert evaluations, the possibilities of distance learning programs are constantly increasing: the number of universities and the quality of distance learning technologies are increasing (up to 80% of universities provide access to educational portals where students can learn the necessary educational material) (Fedorov et al., 2017; Kashtanova, 2017; Medvedeva and Dvurechanskaya, 2016).

The study also addressed the question of the prestige of engineering specialties. In 5% of the responses, it was noted that a stereotype has developed in society, that the work of an engineer is boring and routine, and engineers seem to be uncommunicative and reserved people

It should be noted that there are universities that have managed to adapt the education system to the requirements of inclusion. Of particular interest from the point of view of the objectives of this article is the experience of BMSTU, in which adapted educational programs of engineering education for students with hearing impairments (more than 200 people) are created and are being implemented as part of undergraduate, specialty and master's

programs. Program developers have fully taken into account the special conditions of access to vocational education and the special needs of students with disabilities and difficulties (Fedorov et al., 2017; Kashtanova, 2017). Interesting is the experience of teaching students with difficulties at Perm National Research Polytechnic University. It was found that the problem for students with difficulties in three engineering departments (applied mechanics and mathematics, aerospace and mechanical-technological) is a significant lag behind the normative terms for the development of curricula (Skamyanova, 2016: 55). For successful inclusion in the process of study and professional life, students needed to create individual adaptation programs. The creation of such programs and targeted pedagogical support in the context of the requirements of a technical university helped to keep up to two-thirds of people who, due to poor performance, would be expelled from the course.

5. CONCLUSION

1. Professional education in modern conditions is a social elevator for people with disabilities and PWD.

2. The modern approach to affordable education is based on the concept of inclusion of persons with disabilities in the life of communities, which has proven itself in world practice.

3. The actual content of accessible education practices may vary. An inclusive approach based on the following criteria is common: 1) *University opportunity to teach students with difficulties* (assumes the availability of training programs and manuals for teachers and support staff of universities aimed at implementing the principles of inclusion); 2) *accessibility of studies for students with difficulties* (includes the solution of such issues as the payment of educational services, the creation of a training infrastructure, the formation of an institution for the coordination of training, the relationship of the training system for people with difficulties with the labor market).

4. It is difficult to compare the world and Russian practices of affordable education, because today, foreign inclusive education programs have shown good results, and in Russia inclusive education is only expanding.

5. Russia's lag in the development of an inclusive education system is explained by a number of reasons. One of the significant ones is the isolation policy in the education of children with difficulties, which has the support of educational entities (teachers and parents).

6. Inclusive education in Russia is developing in many areas. The best foreign practices of building an accessible environment (barrier-free architecture, pedagogical adaptation of the educational process) can be borrowed and adapted to the peculiarities of the Russian higher education system.

7. A study of the accessibility of education in universities of the Russian Federation for students with SLN, conducted on the basis of a survey of students and their parents, made it possible to name difficulties in registering HE and obtaining IPRH as the main factor.

8. A survey of teachers and students of technical universities showed that the main problems in training future engineers, which ultimately lead to a low demand for engineering specialties, are: the quality of school training and the level of development of the intellectual abilities of future applicants.

9. There is Russian experience in teaching disabled people and people with PWD engineering specialties, which has proved the need for systematic interaction between teachers and students to overcome the learning difficulties of future engineers and their adaptation to the requirements of a technical university based on individual rehabilitation programs.

10. The solution to the problem of supporting people with disabilities and PWD, in the field of access to education and further social inclusion in society, is only possible by joining forces at the local, national and international levels.

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