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HIGHER TECHNICAL EDUCATION SYSTEM IN GERMANY

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Abstract. The article offers a description of the system of higher technical education in Germany. Being a leading country, it has been implementing new stages, schemes and plans of the education development for many centuries; its learning technologies are borrowed from other countries, and students from all over the world dream of getting into one of the higher education institutions. This country is one of the leading countries in the technical specialists training, and therefore it is analyzed and systematized the system of higher technical education in Germany in the article. The higher technical institutions are divided into universities and higher applied professional schools and the curriculum examples are provided. There are different study areas in German technical universities and they are represented and compared. Different education programs at various faculties of educational institution are described in the article. The learning hours are defined, the practical and theoretical percentage of studying is illustrated. It is discussed that professional higher technical education in higher applied professional schools in Germany is based on the dual training of workers in various specialties. The dual training system is defined. The number of international students, the countries where they come from are shown. It is stated that Germany is an open country for international students and study here is widely oriented on new comers. It is actualized the education payment ways and described the possibilities of free learning. The authors conclude that universities represent a general model of learning while a student may combine learning with work in higher applied schools. A student can choose between full-time and part-time forms of studying.

Keywords: education, technical education, higher technical education, curriculum, universities, applied professional schools of Germany, tuition fee, student fee.

1. INTRODUCTION

Over the years higher technical education system around the world is constantly changing and updating, there is a demand for new professionals in various fields of human activity, there is a question of rapid mastery of the necessary material, its quality assimilation and demonstration. The countries of the European Community have been at the forefront of training highly skilled professionals for many years, so it is safe to say that their views on how to create and implement higher education are systematic and effective.

Studying abroad insanely expands and deepens everyone's knowledge, new horizons and opportunities open up. There are many benefits, both personal and professional. It is an experience

that will change your life for the better, help you become independent, succeed in the labor market, create memories and friendships for many years.

Germany's higher education system is a guide for curriculum. On the one hand, it is difficult because there is a number of professional schools and universities that offer different views on the educational process. However, each entrant is able to choose the profession, program and tuition fee that he/she likes and is able to afford. Besides, all higher education institutions offer a high level of training, have close cooperation with companies that occupy leading positions in the labor market.

2. ANALYSIS AND DISCUSSION

The higher technical education structure is complex and may differ in different parts of the federal states. The German system of higher technical education is of a very high quality and affordable; admission can be without entrance exams, there is freedom of choice in the certain disciplines study. Students have an opportunity to work while studying, there exist programs of academic mobility of students for a semester or two to other countries without interruption. Thus, there are many benefits for German students and international students during their education and, as a result, a high employment chance in various European countries.

The vast majority of educational institutions in Germany are public, they are funded from the federal or local (land) budget. There are also private educational institutions, but they must meet standard requirements and have a state license to teach.

Accreditation is required in order to meet the standard requirements and have a state license to teach at a higher education institution. According to N. V. Vasilkova Germany is characterized by a three-tier accreditation system:

1) The Federal Lands Germany Ministers Conference (GMC): they are responsible for education, upbringing, higher education, science and culture; make major decisions and address common land requirements for the system structure.

2) Accreditation of Curriculum in Germany Foundation (Stiftung zur Akkreditierung von Studiengängen in Deutschland) - organizes methods to ensure the quality of education, in particular through the agencies accreditation, defining requirements for the evaluation system structure and quality assurance further development.

3) Accreditation agencies conduct accreditation and develop their own instructions, approaches and catalogs of criteria based on the decisions of the GMC and the Accreditation Council. The German Accreditation Council recognizes ten agencies (8 - from Germany, 1 - from Austria, 1 - from Switzerland). The Agency receives the right to award a quality mark to any curriculum after the accreditation process conducted by the Accreditation Council. The Agency undertakes to use the accreditation rules of training programs set by the Accreditation Council for the system accreditation. [9]

In Germany, higher technical educational institutions are divided into two types: classical universities (Universitäten) and applied higher professional schools (Fachhochschulen). The main difference between them is the training practicality and the internship possibility during the last study semester.

The vast majority of entrants (both native Germans and international students) prefer classical universities because special attention is paid to classical sciences. Traditionally, the university trains lawyers, doctors, specialists in natural sciences (chemists, biologists, physicists), engineers, financiers, managers, as well as sociologists, historians, linguists. In addition to teaching at each university, research work is conducted in which students participate.

In addition, there is a system of supervisors, as well as senior mentors who help understand and properly make the choice of academic courses. The advantages of studying are the

opportunity to choose those courses that seem more appealing to a certain student and to arrange an individual study plan.

The most famous classical technical universities in Germany are Berlin Technical University (1770), Karlsruhe Technical University (1825), Stuttgart University (1829), Munich Technical University (1868) and Dortmund Technical University (1968). These higher education institutions have accepted the largest number of students for many centuries, have a separate culture of teaching, centuries-old traditions and a stable statute.

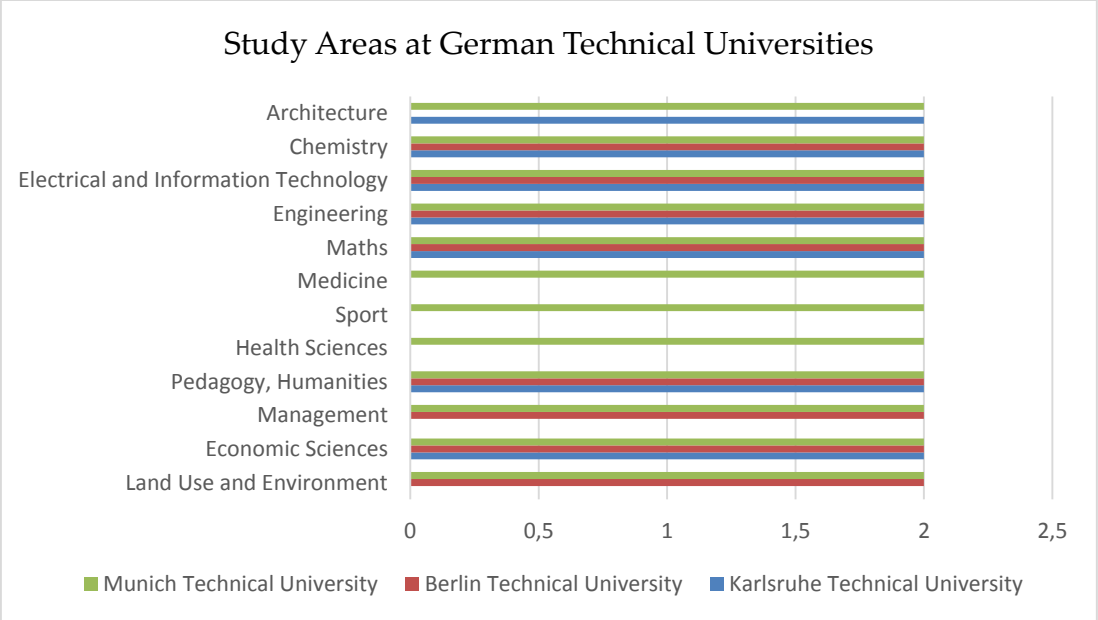
Munich Technical University is the only technical university in Bavaria, one of the largest higher learning German institutions. Today, the university has 132 specialties, including technical, economic, natural sciences, sports and medicine. The main emphasis is on the subjects study of technical and natural cycle, active research work.

Berlin Technical University is an example of Germany's leading higher technical education. It provides an opportunity to conduct active research activities in various fields: physics, chemistry and mathematics. It has more than a hundred specialized educational programs, more than 40 scientific institutes operate on the basis of the university. Students have the opportunity to carry out innovative technical developments in the field of applied disciplines.

Berlin Technical University is open to its students, as they can draw up their own curriculum. Of course, there are a number of normative disciplines for each specialty, but there are no academic groups at the university, as each student attends classes that he or she finds appropriate.

Karlsruhe Technical University is both a leading higher education institution and a research center. Both teachers and students are actively involved in the development of applied inventions and projects. Most students find a job before graduation. The institute provides an opportunity to get an education in the following specialties: natural sciences, engineering, economics, humanities and teaching methods at school.

Speaking of the largest technical universities in Germany, we can summarize the study areas offered to Germans and foreign students.



Tab. 1. Study areas at German technical universities

Table 1 shows that Munich Technical University offers the largest number of specialties, namely entrants can choose medicine, sports, health sciences. Karlsruhe Technical University has architecture, and Berlin Technical University has a degree in land use and the environment.

It should be noted that there are some common requirements for the curriculum structure in all the universities. The curriculum is as clear as possible presenting all the subjects and modules that are a part of the educational program. Normally, the sequence in which the student must attend these modules is suggested. In addition, one can see the weekly semester academic hours and the points distribution.

The amount of student workload (the complexity of training) is set in academic credits. The loan provides all types of educational activities required to complete a full academic year training in the institution, for example: lectures, practical work, seminars, consultations, individual, independent work (in the library or at home), final control (exams, tests), diploma work, pedagogical, educational and industrial practices or other activities, related to evaluation. The loan, therefore, is based on the full workload of the student, and is not limited to classroom hours.

The price of the loan is 36 academic hours (usually 18 hours are classroom classes, 9 – individual work of the teacher with students, 9 hours – students independent work). The ratio of classroom and individual and independent classes is also possible – 60%: 40%, 40%: 60%. [1]

Regarding the conditions of entry and the system of higher technical education in Germany, it is necessary to compare higher technical educational institutions and the educational programs they offer. Different faculties of technical universities were selected for comparison.

	Berlin Technical University	**Munich Technical University**	**Karlsruhe Technical University**
Education level	Bachelor, Master	Preparatory Course, Bachelor, Master	Bachelor, Master
Faculty	Applied Mechanical Systems	Management and Technology	Engineering
Instruction languages	English	English only for "Computer Engineering" specialty, 55% are taught in German and 45% in English for other specialties	English
Program duration	7 semesters	6 semesters	6 semesters
Semester beginning	It is possible to start with the winter and summer semesters	Start only with the winter semester	Start only with the winter semester
Tuition fees (student fees)	For international students from non-European countries - 4,500 euros for 1 semester; For students from countries that are members of the European Union - 650 euros per month.	Absent	For international students from countries outside the European Union – 7,000 euros.
Program description	The curriculum includes: mechanical engineering, electrical engineering, computer science, mathematics, physics, statistics,	The program combines management courses (70% of studies) and engineering or science (30% of studies). Students master a	The program is divided into key disciplines, culminating in specialization in energy engineering, automotive engineering

	programming and intercultural communication. It is possible to obtain a certificate of the first or second degree "Siemens Mechatronic Systems Certificate Program (SMSCP")	fundamental understanding of business issues and a basic understanding of technology and innovation. The university has close ties with well-known companies: BMW, BCG, Commerzbank, E.ON, Siemens and Telefónica O2 Germany.	and global production management.

Tab. 2. Comparative characteristics of German technical higher education institutions.

As we see from Table 2, not all German higher education institutions offer free tuition to foreign students. Applicants from countries that are members of the European Union have greater advantages. Basically, the study duration for the educational qualification degree "Bachelor" is from three to four years, and "Master" one or two years according to the university program.

Master's programs that exist in universities can be divided into three types:

1) consecutive (konsekutiv) – assumes that the student is studying in the specialty he received earlier;

2) qualification level raising (weiterbildend) for those who graduated from university a few years ago and have already gained work experience;

3) inconsistent (nicht konsekutiv) indicates a partial change in specialization. [7]

Students have the right to start the academic year from the winter or summer semester. The winter semester starts mostly in October and is over at the end of March, but in different federal states the beginning varies and sometimes the winter semester starts in September. The summer semester begins in April and ends in late September. Its beginning also depends on the federal system.

Almost all German universities provide a wide range of knowledge, and their educational programs include both lectures and practical classes. The most important feature of each educational institution is the internship possibility in world-famous companies. This is a characteristic feature that indicates the university level. Therefore, students prefer to choose the university where there is a better opportunity for employment after the internship.

We would like to remind you that there is another type of higher technical education in Germany – higher professional schools (Fachhochschulen). They have a greater practical orientation in education and arose on the basis of engineering schools. The term of study here is much shorter, but much attention is paid to the applied use of knowledge. In such schools, future programmers, economists, managers study, who are more interested not in classical disciplines, but in practice, internships at enterprises. Training lasts 3-4 years. [4]

Professional higher technical education in higher professional schools in Germany is based on the dual training of workers in various specialties. This means that the educational services provision is carried out through the system of apprenticeships in enterprises. This model includes systematic vocational training in a separate institution or enterprise (approximately 4 days per week) and mandatory theoretical support in an educational institution (2 days per week, approximately 10 hours of lectures).

Dual training system begins with the conclusion of the "Agreement on Industrial Apprenticeship" between the prospective student and the enterprise owner. This agreement defines the purpose of training, professionalism after graduation, method and content of training,

beginning and duration of training, training activities outside the company, working day length, probationary period duration, payment terms and salary, leave duration, conditions under which the agreement may be broken. Upon graduation, students receive an international bachelor's degree and work experience that is valued by employers.

You can study in higher professional schools in the following specialties [8].

A	**B**	**C**
Aerospace Technology Architecture Air Traffic Controller Audit Accounting and Auditing Aircraft Construction Air Traffic Control Assistant Doctor Applied Computer Science	Business Administration Business Informatics Biology Biotechnology	Construction Commercial Law Children's Pedagogy Care Consulting Commercial Specialist (High School Graduate Program) Computer Science Communications / PR Communication Design Customs Chemistry Chemical Engineering Civil Engineering
D	**E**	**F**
Design Digital Media	Economic psychology E-commerce Electrical Engineering Energy and Construction Technologies Energy Ecotrophology Engineering Events Organization	Fashion Fairs, Congresses and Events Organization Finances Fitness Economy Fitness Training Food
G	**H**	**I**
Gastronomy Governance	Hotel Management Health Economics	Interior Design Information Technology Innovation / Product management IT Management International Business International Management Industry Insurance
J	**L**	**M**
Journalism	Law Labor Market Management Landscape Architecture Logistics	Marketing Maths Mechatronics Media Design Media Informatics Medical Insurance Medical Technology
N	**O**	**P**
Nutrition Management	Obstetrics	Pension Insurance People Management Plastics Technology

		Pharmacy Physiotherapy Police Psychology Public Service Production Equipment Process Technology / Process Management
R Real Estate Industry	**S** Sales Engineering Sports Economics Service Management Speech Therapy Shipbuilding Social Work Social Management Social Pedagogy Social Insurance Sport Sports management	**T** Taxation Teacher Trade Management Textile and Clothing Technology Tourism Trade
V Vehicle Technology	**W** Wood Technology	

Tab. 3. List of specialties offered by applied professional schools in Germany

As can be seen from Table 3, despite the fact that dual education is associated to some extent only with technical specialties, German higher applied schools offer students humanities too.

Four types of dual education:

1) Double learning program. This is the only dual option where you can get a bachelor's degree in some important areas, such as nursing. Simultaneously with the bachelor's degree is an internship in a partner company of the university.

After the study successful completion, it is possible to obtain an academic diploma of the university and additional professional qualifications. This is definitely an advantage of this education option. The disadvantage is that in addition to working at the company and lecturing at the university, you also need to attend professional school. So, this means that students have even more workload. It is important to know that there is a block or weekly model in dual curriculum, as universities and companies have agreed on this concept.

2) Double learning program integrates practice. There is a wide choice of options for an integrated or joint double learning program. This model is structured similarly to the above-mentioned learning model, it is taught mainly in a block or weekly model. There is only one significant difference: students do not complete vocational training only in practical stages, they attend professional school and listen to theoretical material. The student is employed as an intern or as a regular employee, not as an apprentice.

There are several options for practical experience gaining. However, as a rule, students work in the company during the entire period of study and undergo various stages of professional training to get an idea of different areas.

3) Robotics-oriented dual training program. The option is designed for those who already have a permanent position and want to continue their education in the specialty. If you choose this training program, the number of hours worked at the company is reduced in agreement with the company and time is provided for training. Therefore, the necessary condition is the support of the employer. The peculiarity is that such a curriculum is available not only for a bachelor's degree, but also for a master's degree.

4) External program / practical double course. This education model is structured in the same way as the usual form of distance learning, because in most cases it ends in parallel with full professional activity. The difference from the "regular" course is that here the employer is openly involved and supports the student, for example, dismissing from the full-time stages or through further funding. Preferably, in addition to the usual 40-hour week, the student may study in the evening or undergo distance learning. [2]

In today's world, Germany has a favorable geographical position and borders with nine countries, so the implementation and organization of higher technical education takes into account the needs of not only one country but also those nearby and can increase the number of students.

If we talk about classical universities and applied schools, it is advisable to consider the number of international entrants entering. [5]

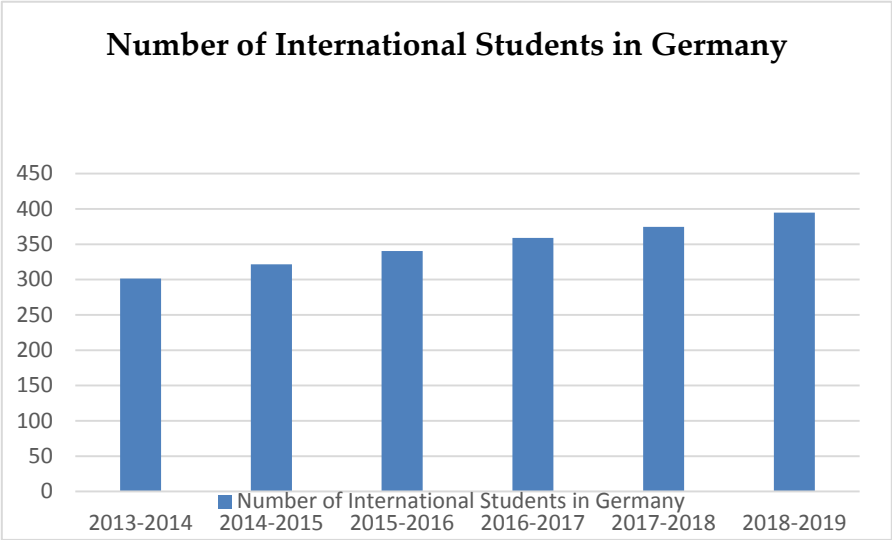


Fig. 1. The International Students Growth from 2013 to 2019 academic year

It is obvious that since 2013 the number of students in higher education institutions in Germany has increased by 30.9%. If in 2013 there were approximately 301,350 entrants from around the world, in 2019 this mark reached 394,665 students. Tuition at public universities is mostly free, especially if the language of instruction is German only, but from 2007 in some parts of Germany a semester fee (Semestergebühren) may be charged, ranging from € 500 and up. [5]

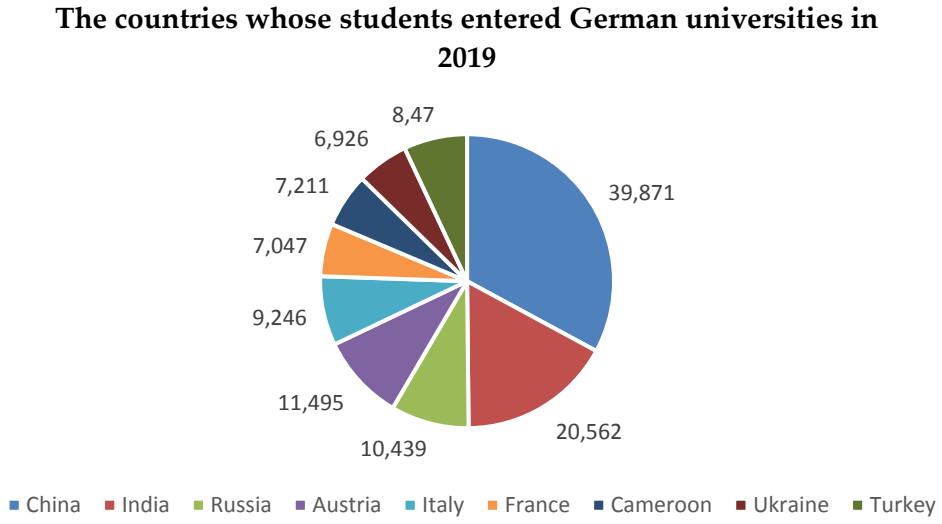


Fig. 2. Number of students who entered German universities in 2019.

As can be seen in Fig. 2, the largest number of international students is observed from the following countries: China, India, Russia, Austria, Italy, France, Cameroon, Ukraine and Turkey. China has traditionally been the largest distributor of applicants, with a large percentage of young people seeking to move to European countries. Moreover, after graduation, students will be able to work freely in Germany, and some of them find a permanent job before graduation. [5]

There are two concepts in the German higher education system: tuition fees and student fees (registration fees). Unlike tuition fees, student fees exist at all universities. The student fee is a mandatory payment that covers administrative costs, sometimes it includes a ticket for all modes of transport for the semester. At different universities, it ranges from 100 to 300 euros per semester, sometimes more. [6]

Tuition fees are a significant factor influencing the choice of university. Both students from other countries and native Germans are not willing to spend large sums on tuition or student fees. However, the trend remains the same: if a student plans to study at one of the leading universities, the fee is much higher. The question arises: where do they get money for training? According to statistics, we have the following data.

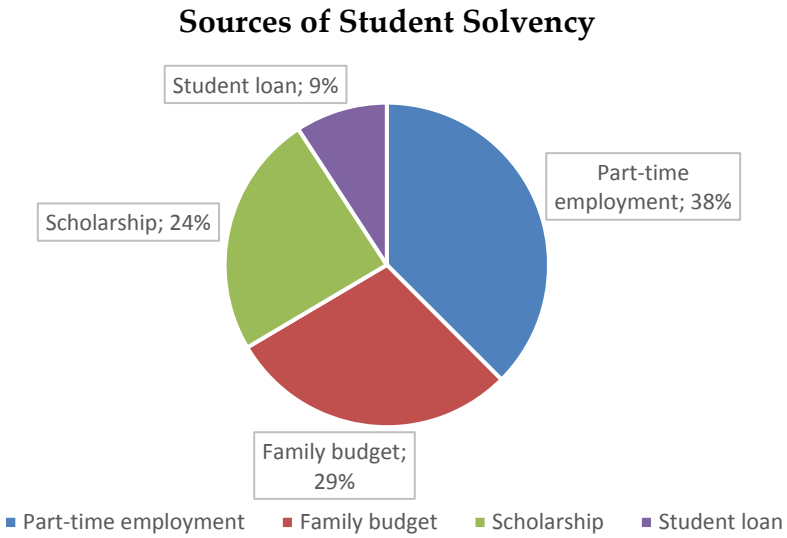


Fig.3. Sources of student solvency.

The chart shows that the largest percentage of students plan to combine work with study. 29 percent rely on family income or their own savings. 24.3 percent of applicants rely on scholarships, and 9.2 percent take out study loans, with a mandatory payment condition in the years following graduation.

3. CONCLUSIONS

Higher technical education in Germany can be obtained at a university or in higher applied professional schools. Universities offer a general model of learning, while in higher applied schools you can combine learning with work. There are full-time and part-time forms of study.

The system of higher technical education in Germany is developed and multifaceted. Over the years, it has been improving and developing in accordance with the new requirements of the labor market. At present, practical skills have an advantage over purely theoretical knowledge. Moreover, the combination of work and study gives you the opportunity to earn independently and thus, if necessary, pay for training.

Students of all higher education institutions receive European diplomas, and therefore have the opportunity to work in different European countries on equal terms. Some of the graduates may be

enrolled in various departments of the university for a permanent job before graduation. In general, there is a number of advantages in the German higher technical education system:

1) good quality and reputation;
2) no tuition fee (but there are student fees);
3) many employment opportunities;
4) knowledge exchange;
5) possibility of internships in global companies;
6) ability to create an individual study plan by varying the sample of courses;
7) possibility of joining winter or summer periods;
8) ability to choose the instruction language (English or German);
9) opportunity to work in the European Union on equal terms after graduation.

The above advantages prove that the system of higher technical education in Germany is developed and universal, meets the requirements of society and accepts the challenges of today.

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Андрійчук Наталя, Динович Анна. Система вищої технічної освіти Німеччини. *Журнал Прикарпатського університету імені Василя Стефаника*, **9** (1) (2022), 112–122.

У цій статті описано систему вищої технічної освіти Німеччини, яка є передовою країною, яка вже багато століть впроваджує нові етапи, схеми та плани розвитку освіти; її технології навчання запозичують інші країни, а студенти з усього світу мріють потрапити до одного з вищих навчальних закладів. Ця країна посідає одне з перших місць щодо підготовки фахівців технічного профілю, а тому є важливим проаналізувати та систематизувати систему вищої технічної освіти Німеччини. Вищі технічні заклади поділяються на університети та вищі прикладні професійні школи, наводяться приклади навчальних програм. У німецьких технічних університетах є різні напрями навчання, які є представленими та порівняними. У статті описано навчальні програми на різних факультетах закладів освіти. Визначено години навчання, проілюстровано практичний та теоретичний відсоток навчання. Вказано, що професійна вища технічна освіта у вищих прикладних професійних школах Німеччини базується на дуальному навчанні робітників за різними спеціальностями. Визначено сутність дуальної системи освіти. Показано кількість іноземних студентів та країни, з яких вони прибувають. Зазначено, що Німеччина є відкритою країною для іноземних студентів, і навчання тут широко орієнтоване на них. Представлено способи оплати навчання та можливості безкоштовного навчання. Автори приходять до висновку, що університети представляють загальну модель навчання, в той час, як студент може поєднувати навчання з трудовою діяльністю у вищих прикладних школах. Абітурієнт також може обирати між денною та заочною формами навчання.

Ключові слова: освіта, технічна освіта, вища технічна освіта, навчальний план, університети, прикладні професійні школи Німеччини, плата за навчання, студентські внески.