



ARTICLE  
SPECIAL SECTION

*Borders in Globalization Review*  
Volume 6, Issue 2 (Spring & Summer 2025): 60–69  
[https://doi.org/10.18357/big\\_r62202522133](https://doi.org/10.18357/big_r62202522133)

# Digitization in Higher Educational Institutions as a Catalyst for Cross-border Cooperation

Marija Mendzhul

*This article explores the concept of “digitization” and the influence of information technologies on the provision of educational services and the activities of universities in Ukraine and the EU. We provide an analysis of plans for the digitalization of education in the EU and review the advantages and disadvantages of the introduction of remote (online) education, as well as the ways in which the digitalization processes taking place in education in the EU countries and Ukraine affect cross-border cooperation among higher educational institutions. We offer some proposals for the development of digitalization of cross-border cooperation.*

**Key words:** digitization, higher education institutions, academic mobility, contract, cross-border cooperation.

## Introduction

The COVID-19 pandemic and subsequent full-scale war in Ukraine have shown how digitalization processes help to make various services available even in crisis and emergency situations. These processes did not bypass the sphere of education and the activities of higher educational institutions, which are active participants in cross-border cooperation. For the post-war reconstruction of Ukraine, the issue of cross-border cooperation is a priority, and higher educational institutions can be an expert platform for inter-state dialogue and the exchange of experience at various academic levels (students, graduate students, and teachers), both of which will ultimately contribute to the technological development of various states.

Ukraine borders seven countries: Poland, Slovakia, Hungary, Romania, Moldova, Russia, and Belarus. The total length of the Ukrainian border is just under 7,000 kilometers. As part of our research, we will focus on cross-border cooperation between higher education

institutions in Ukraine and four neighboring European countries—Poland, Slovakia, Hungary, and Romania.

This research is based on a systematic approach that includes a set of methods for studying the digitalization of educational services provided by higher education institutions as a catalyst for cross-border cooperation. In particular, the following methods were used: the historical method (clarifying changes in the processes of legal regulation of academic mobility in Ukraine and individual European countries and revealing what changes have occurred in education under the influence of global digitalization); the desk research method (allowing us to analyze various cross-border cooperation programs and identify which elements of digitalization were applied); the field method (helping to find out what agreements were concluded at Uzhhorod National University for cross-border cooperation with other European universities); the formal-dogmatic method (allowing us to clarify the

**Marija Mendzhul**, Doctor of Science of Law, Professor of the Department of Civil Law and Procedure, Faculty of Law of the Uzhhorod National University. Contact: [mendzhul.marija@uzhnu.edu.ua](mailto:mendzhul.marija@uzhnu.edu.ua). ORCID iD: [0000-0002-3893-4402](https://orcid.org/0000-0002-3893-4402)



concept of digitalization and its impact on education); the dialectical method (allowing us to identify trends in cross-border cooperation of universities under the influence of digitalization); the comparative method (playing a key role in identifying differences in the legal regulation of educational services in Ukraine and European countries, as well as changes made to legislation under the influence of digitalization); and the forecasting method (allowing us to develop specific proposals that will improve the activities of educational institutions within the framework of digitalization and cross-border cooperation). The application of these methods systematically and in combination led to the formation of our conclusions and proposals.

In the European scholarly literature, one can find many focused publications on the digitalization of different levels of education. In 2019, the "Digital Education Vision for the European Schools System" (DEVES) was published, including the main future steps for the improvement of digital competence, which is key for both students and teachers as well as for the modernization of schools (Schola Europaea 2019). Subsequently, a more detailed report was published, which gave an overview of trends in the digitalization of school education and proposals for policies and strategy development (European Commission 2019). The aforementioned publications reveal certain trends and problems in the digitalization of education at the level of the school system, but do not cover the specific features of schools in border regions, including linguistic and cultural features, nor how digitalization affects these features.

In addition, the EU has published a systematic review entitled "Digital Education—Factors that Contribute to Success", which reflects the analysis presented in the DEVES and contains a number of recommendations. It highlights the importance of policies to support the digital transformation of higher education and research as envisaged in the European Strategy for Universities, as well as in various commitments to the European Research Area. The European University Association (EUA) strongly recommends starting a policy debate on the principles underlying this transformation at the European level and on the goals it is meant to achieve. It is vital to develop value-based approaches and to ensure that the university's administrative and academic staff have appropriate digital skills, including digital pedagogy, that are based on open and ethical standards for new digital technologies (Digital Education 2022). While there are quite important conclusions regarding the technical improvement of the material base at the university, the development of technical skills among staff and teachers, and most importantly, the value orientation of all transformations and changes, there is no analysis or recommendation list regarding cooperation between universities within the EU and beyond European borders, in particular within border regions.

A comparative study of cooperation between European universities and individual universities outside the EU, including Ukrainian universities, concluded that "blended learning", whether hybrid or Hyflex-learning, is important to overcome the fixation on face-to-face physical education compared to face-to-face online education, as well as to introduce a wider range of learning opportunities and methods. However, the authors noted the problem of political and financial support for both the development of institutional strategy and capacity building—in particular, European and international exchange and cooperation, staff development, and institutional development (Gaebel et al. 2021). At the same time, the aforementioned report analyzed only seven universities in Ukraine and their cooperation, and did not address the possibilities and aspects of cross-border cooperation for Ukrainian universities. In light of this, our study is innovative and unique, as it analyzes the impact of digitalization on cross-border cooperation between universities in Ukraine and European universities within border regions. Proposals have been developed to improve the mechanisms that facilitate cross-border cooperation between higher education institutions in the context of global digitalization in order to create a single expert online platform: intergovernmental dialogue, the exchange of experience at different academic levels (students, postgraduates and teachers), the optimization of academic mobility and the simplification of the systems to recognize diplomas and confirm qualifications.

### **The Concept of "Digitalization" and its Impact on Educational and Other Activities of Higher Education Institutions in Ukraine and the EU**

Digitization has especially accelerated under the influence of globalization processes. The Cambridge Dictionary defines digitization as "the use or association of digital signals with computer technology" or "the representation of information in terms of numbers (0s and 1s)" (Cambridge Dictionary 2025). Wikipedia notes that when digitization is defined, it is "the process of converting information into a digital (i.e., computer-readable) format, resulting in a representation of an object (image, sound, document, or signal) by generating a series of numbers that describe a discrete set points or samples" (Digitization 2025). In scholarly articles, European researchers use the term "digitalization" more widely to mean "people's ability to use digital services", while in education it translates into "the practice of teaching and learning remotely from algorithm-based ways of working" (Armila 2022).

In Ukraine, both terms—"digitization" and "digitalization" are also used in parallel. At the same time, this occurs primarily among scholars. Some use the term "digitalization" to denote processes in electronic

governance (Digitization in Ukraine) and management enterprises (Veretennikova 2021, 42–43), or in analyses of the impact on society and youth (Omelchuk 2020, 296–300). Other scholars specifically use the term “digitalization” when studying the provision of various services (Svitlak 2021) or application in the public administration system (Savchenko 2022).

When analyzing such terms as “digitization” and “digitalization”, Mihrovska concludes that “digitization” is a synonym of “digitalization” in translation (Mihrovska 2021). We can agree with this position, because the analysis of the content of scientific publications showed that the terms “digitalization” and “digitization” are used in the vast majority of cases for the same processes that occur under the influence of digital transformations and technological development.

At the same time, it is worth noting that in Ukraine, at the level of state authorities, the term “digitalization” prevails, for example, the digital portal “Diya” (Digital Transformation n.d.). In addition, the First Educational Information System (EIS) portal was connected to the leading Automated Information Complex of Educational Management (AICEM), and on July 3, 2023, a corresponding agreement was signed that will improve the e-bookkeeping system and optimize data collection, avoiding repeated paper submissions to the information-communication systems (Digitization of Education). In the EU, the term “digitalization” is also used at the official level. Thus, the first Education Digitalization Action Plan was approved in 2018 (Digital Education 2018–2020). Taking into account the above, we used the term “digitalization” in this study.

The first thing that comes to mind when defining the term “digitalization of education” is online learning. Undoubtedly, the COVID-19 pandemic has accelerated the provision of educational services remotely. At the same time, a number of professions require full-time training in order to acquire the necessary practical skills. The conducted study showed that the number of applicants who completed a full online training course if it was free was only 15 percent, and in the case of payment, 45 percent (Yachmenyk 2023). At the same time, among the main problems are the quality and oversight of online education. At the same time, distance education opens up new opportunities for training people with special needs and creates a technical basis for the development and implementation of joint courses of higher education institutions of different states, which can stimulate and improve the quality of educational services by providing them within the framework of cross-border cooperation.

On September 30, 2020, the EU adopted a new plan for the digitalization of education for the period 2021–2027 (Digital Education 2021–2027). The adoption of this plan was preceded by thorough research by the Organization for Economic Cooperation and Development (OECD),

which as of 2018 showed that on average, fewer than 40 percent of educators in EU countries are ready to use digital technologies in education, more than a third of 13-to-14-year-olds who were studied lacked basic digital skills, and a quarter of low-income households do not have access to computers. Further research revealed that 95 percent of respondents believe that the COVID-19 pandemic is a turning point for the use of technology in education and training (European Digital). Similar processes took place in Ukraine, where the COVID-19 pandemic led to the rapid digitalization of educational services and remote access to training and scholarly research.

The Digital Education Action Plan (2025) in the European Union is an updated policy initiative that reflects common approaches to the implementation of high-quality, inclusive, and accessible digital education. This plan aims to strengthen European cooperation in the field of digital education in order to, on the one hand, overcome the challenges associated with the COVID-19 pandemic, and on the other, create new educational opportunities for teachers, students, researchers at various levels—national, European, and international.

The Digital Education Plan in the EU provides for the implementation of the following priority directions:

- 1) promoting the development of a highly effective digital education ecosystem through: structured dialogue with member states regarding digital education and skills; proposals for recommendations on key factors that contribute to successful digital education and training; recommendations for blended learning approaches for high-quality and inclusive primary and secondary education; European Digital Education Content Framework; connectivity and digital equipment for education and training; plans for digital transformation of educational and training institutions; ethical recommendations for the use of artificial intelligence and data in teaching and learning for teachers;
- 2) increasing digital skills and competencies for digital transformation through: general guidelines for teachers and educators on developing digital literacy and combating misinformation through education and training; updating the European Digital Competence Framework to include artificial intelligence and data-related skills; European Digital Skills Certificate (EDSC); recommendations for improving the provision of digital skills in education and training; cross-national data collection on students’ digital skills; digital opportunities internship; participation of women in STEM, etc.” (Digital Education 2021–2027)

An important step for the implementation of these initiatives was the creation by the European Commission of the European Center for Digital Education, which aims to strengthen cooperation and exchange in the

field of digital education at the level of EU member states (European Digital).

### **Digitization and Cross-Border Cooperation of Higher Education Institutions in the Field of Academic Mobility**

The digitization of education in EU countries and Ukraine also affects the process of cross-border cooperation of higher education institutions. Taking into account the provisions of Art. 1 of the Law of Ukraine "On Cross-Border Cooperation" (On Cross-Border 2004), higher educational institutions are participants in cross-border cooperation, which can be carried out for various purposes—in particular, for "establishing and deepening economic, social, scientific, technological, ecological, cultural, and other relations". The Law of Ukraine "On Higher Education" does not mention cross-border cooperation; rather, it notes the possibility of academic mobility, which allows not only study, but also teaching, internships, and other scholarly activities in various educational and other academic institutions within Ukraine and abroad (On Higher Education 2014).

Thus, higher educational institutions, in accordance with the legislation and their statutory documents, can enter into agreements on cooperation and partnership with other educational, scientific, or research institutions, as well as with other participants of cross-border cooperation. Cooperation is possible for the implementation of joint educational and scientific projects, conducting cross-border research, academic mobility, joint events (conferences, round tables, seminars, etc.), and the exchange of scholarly and other information.

An important component of cross-border cooperation between higher education institutions is academic mobility at different academic levels. In order to guarantee academic mobility, the European Credit Transfer and Accumulation System (ECTS), which allows students to confirm qualifications and educational components, was implemented in Ukraine. This was a logical decision following the implementation of the provisions of the Convention on the Recognition of Higher Education Qualifications in the European Region dated April 11, 1997 (Convention on Recognition 1997). Based on the provisions of this Convention, the Law of Ukraine "On Higher Education" contains a number of norms that mention and grant the right to academic mobility (Articles 1, 4, 13, 44, 46, 57, 62, 74, and 75). The Cabinet of Ministers of Ukraine issued a separate resolution entitled "Issues of the National Information Center of Academic Mobility" (The Issue 2011).

Currently, the National Information Center for Academic Mobility (ENIC UKRAINE) is tasked with the following: provision of unhindered access to information regarding the integration of the national education system into the European educational space; provision of information

and clarification regarding academic mobility, as well as recognition of educational documents; verification of the authenticity of the educational document issued by Ukrainian and foreign educational institutions; revision of inquiries regarding the establishment of equivalence for qualifications awarded by an educational institution based on the document on the education of foreign nationals; preparation of drafts of bilateral and/or multilateral intergovernmental agreements on the recognition of qualifications; promotion of educational services provided by Ukrainian educational institutions abroad; implementation of international academic exchange programs for pupils, students, and postgraduates; and organizational provision of training, internships, or advanced training of Ukrainian citizens in educational institutions of other states (National Information).

Similar institutions were created in Austria and other EU countries. Thus, in Austria, for citizens of the European Union or the European Economic Area, as well as citizens of Switzerland, access to regulated professions is regulated by the EU Directive on professional recognition (Directive 2005/36/EG). It provides rules for the mutual recognition of professional qualifications and thus ensures free access to the labor market of the EU member states. On July 12, 2016, a new Act on the Recognition and Evaluation of Qualifications Obtained Abroad (AuBG) entered into force, establishing new procedures for the evaluation of professional qualifications and education. It stated that persons entitled to asylum and persons entitled to subsidiary protection who lost their certificates or educational certificates during the flight through no fault of their own should be able to prove their qualifications through alternative procedures (e.g. practical or theoretical exams, selective tests, technical discussions, or work samples). Digital technologies are actively implemented in this process and an online recognition portal is provided (Berufsanerkennung n.d.). The specified portal contains detailed information on the application process, including information on procedures, competent authorities, and required documents, as well as procedural costs related to the recognition of education and qualification documents.

The Hungarian Center for Equivalence and Information of the Department of Education operates in Hungary. Hungary has been a member of ENIC since 1994 and of NARIC since 1997, and the Hungarian Equivalence and Information Center (HEIC) has since been performing the tasks of the ENIC/NARIC office in Hungary. Until 31 December 2006, the HEIC was a department of the Ministry of Education and Culture. Since January 1, 2007, it has been a part of the Department of Education. The main task of the HEIC is the recognition of certificates and degrees obtained abroad, but it also provides information on Hungarian and foreign education systems and issues certificates of Hungarian qualifications for use abroad. Since the opening of borders in the early 1990s, it has become easier to move between countries



and, as a result, the number of applicants wishing to have their degrees or qualifications recognized in Hungary has increased. The growing number of applicants forced the creation of a central office in 1993, the main task of which was to recognize higher education qualifications obtained abroad, as well as to facilitate the mobility of teachers and students by providing information. At that time, the legal basis for HEIC's activities was the Higher Education Act of 1993 and Government Decree No. 47/1995 on the Recognition and Nostrification of Foreign Qualifications, Degrees, and Diplomas Obtained in Higher Education Institutions Abroad.

Due to the overlap of jurisdiction of various laws regulating the recognition of foreign degrees and professional qualifications, as well as the overlap of the competence of various institutions and administrative bodies, the need to draw up a new consolidated law on recognition arose. In December 2001, the Hungarian Parliament passed Act No. 100 of 2001 on the Recognition of Foreign Certificates and Degrees, which entered into force on January 1, 2002. Title III of the Act, which regulates recognition under EU law, entered into force only after Hungary became a member of the European Union (May 1, 2004). This Recognition Act, which has been amended several times since its inception, regulates all aspects of the recognition of foreign certificates and degrees in Hungary in accordance with international principles (ENIC/NARIC Hungary n.d.).

A National Information Center was also created in the Slovak Republic. Its tasks are performed by the Diploma Recognition Center (CRD) of the Ministry of Education, Science, Research, and Sports of the Slovak Republic. The CRD is part of the ENIC (European Network of Information Centers) and NARIC (National Academic Recognition Information Centers) networks and acts as a support center for the recognition of professional qualifications in accordance with the EU Directive 2005/36/EC on the recognition of professional qualifications. In the case of study abroad, official recognition in Slovakia of the following types is possible: professional recognition (or recognition of professional qualifications), in the case of qualifying for a profession; and academic recognition (extends to continuing education or for any other purpose, with the exception of practicing a regulated profession, for which the level of education or the equivalence of a specialty is determined. All documents are subject to recognition, except for Czech ones, which are automatically equated to Slovak documents due to a bilateral agreement). In addition, in the case of Slovak diplomas and other CRD education documents, apostilles and the super-legalization of documents are possible (Centre for Recognition n.d.).

In Poland, the Polish National Agency for Academic Exchanges (NAWA) was established on October 1, 2017 to coordinate state activities that contribute to the process of internationalization of Polish academic

and research institutions. Its mission is to promote the development of Poland in the field of scholarship and higher education, and its main goals for the period up to 2027 are as follows: strengthen the international cooperation of scholars in the Polish system of scholarship and higher education; strengthen the international cooperation of Polish universities and scholarly institutions; increase the number of foreign students in Polish universities; spread information about the Polish system of higher education and scholarship; and expand international communities of people familiar with the Polish language and culture (The Polish National n.d.).

In the Czech Republic, NARIC is an integral part of the international center ENIC-NARIC, and carries out the following main activities: cooperates with national information centers of other countries; collects information on academic recognition and mobility; provides advice and information about the education system of the Czech Republic; promotes the mobility of students, teachers and researchers; supports the implementation of the Lisbon Convention; cooperates with higher education institutions of the Czech Republic and other interested parties; organizes seminars and workshops on recognition of foreign education; and participates in international projects (ENIC-NARIC Czech Republic 2025).

Digitization already contributes to the activities of the network of Information Centers, which are called upon in various states to promote academic mobility and recognition of diplomas in accordance with the Lisbon Convention. A fairly informative site of the network has been created (<http://enic-naric.net/>), which allows interested parties to get information about the existing network of centers in different states, as well as to find their current contacts. At the same time, in the future, it would be beneficial to create unified online services for several countries within the framework of cross-border cooperation, which would allow requests for information about academic mobility, students, post-graduate students, teachers, and diploma recognition or confirmation of qualifications.

In Ukraine, higher educational institutions are currently developing regulations to promote academic mobility. For example, the Uzhgorod National University separately approved the "Regulations on the Procedure for Recognition (Re-Enrollment) of ECTS Credits for Participants of Academic Mobility Programs at the State Higher Educational Institution 'Uzhgorod National University'" (Regulations 2019) and "Regulations on Academic Mobility of Students at the Uzhgorod National University" (Regulations 2016). On August 31, 2020, the Academic Council of Chernihiv Polytechnic National University approved the Regulation on Academic Mobility of Participants in the Educational Process of Chernihiv Polytechnic National University (Regulations 2020). A similar provision was approved at the Dnipro National University (Regulations 2018),

the Ukrainian Catholic University (Regulations 2020), and other post-secondary institutions.

Academic mobility within the academic period is enabled by the conclusion of agreements between institutions of higher education on international academic mobility. For example, the Uzhgorod National University concluded a memorandum of understanding with the Environmental University of Bucharest (Romania), which provides for joint scientific research and the exchange of teachers and students, joint scientific seminars and conferences, academic mobility of teachers and students, the exchange of publications, etc. (Memorandum 2023) Similar areas of cooperation, including academic mobility, are also defined by the memorandum of understanding between the Uzhhorod National University and the University of Pitesti (Romania) dated December 21, 2022 (The Memorandum 2022). In 2017, an agreement on scientific and cultural cooperation was concluded between the State East European University in Przemyśl (Poland) and the Uzhgorod National University, which provided for the possibility of concluding additional agreements on joint research and didactic projects, and also provided for cooperation through joint research, conferences, information exchange, educational programs, literature, and the exchange of scientific and pedagogical workers, graduate students, and students within the framework of the ERASMUS+Ukraine program (Agreement 2017). Educational and scholarly cooperation is fleshed out in the agreement between the Pomeranian Academy in Slupsk (Poland) and Uzhgorod National University dated June 7, 2019 (Agreement 2019).

In addition, contracts and memorandums regarding the signatories are signed at the level of the individual structural divisions of higher educational institutions. Thus, an agreement on cooperation was concluded between the Faculty of Social Sciences, the Department of Sociology and Social Work of the State Higher Secondary School "UzhNU", and the Faculty of Pedagogy, the Department of Social Work of the University named after J. Komenko in the city of Bratislava (Slovak Republic) (Agreement 2018). This agreement provides for the exchange of teachers, researchers, and students, as well as the joint organization of courses, practices, conferences, seminars, joint master's and undergraduate programs, and the organization of exchanges and other forms of cooperation. Similar norms of cooperation are laid down in the agreement between the Faculty of Social Sciences of the UzhNU University of Applied Sciences and the Faculty of Social Sciences of Marie Curie Skłodowski University in Lublin (Poland) (Agreement 2019). In addition, the Faculty of Law of UzhNU University of Applied Sciences concluded agreements on long-term international cooperation with the Faculty of Law, Canon Law, and Administration of the John Paul II Catholic University of Lublin (Poland), the Faculty of Law of the Masaryk University (Brno, Czech Republic), the Faculty of Law

of the Comenius University in Bratislava (Slovakia), the Law Faculty of Trnava University in Trnava (Slovakia), the Hussite Theological Faculty of Charles University in Prague (Czech Republic), and others.

### **Digitization and Cooperation of Higher Educational Institutions in Scholarship and Implementation of Cross-Border Projects**

There are already successful examples of cross-border cooperation on the implementation of individual projects with the participation of universities. We analyzed supported projects within the framework of two programs: "Hungary-Slovakia-Romania-Ukraine ENPI Cross-border Cooperation Program 2007-2013" and "Hungary-Slovakia-Romania-Ukraine ENI CBC Program 2014-2020". This research showed that within the framework of the "Hungary-Slovakia-Romania-Ukraine ENPI Cross-border Cooperation Program 2007-2013", out of 31 supported projects in which the Transcarpathian region was included, only two projects involved Uzhhorod National University. One of the projects was called "Space Emergency System" - Cross-Border System for Prediction of Natural Disasters Incidents on the Basis of Exploitation of Satellite Technologies in Hungary, Slovakia, Romania and Ukraine"; its implementation dates January 1, 2013-October 31 2015, with a total budget of EUR 537,610.79. Within the framework of this project, it was planned to establish a monitoring and warning system in real time with the aim of reducing the damage from natural disasters, including through satellite technologies (This Is the Website 2007-2013). The goal of the second project, "Interactive Institutional Cooperation: History, Traditions and Culture Without Borders", was the strengthening of cultural and historical ties in the border regions. Along with the state higher educational institution "Uzhhorod National University" (Ukraine), the County Museum of Satu Mare (Romania) participated (Interactive Institutional Cooperation 2025).

The program "Hungary-Slovakia-Romania-Ukraine ENI CBC Program 2014-2020" provided for three rounds of tenders. Projects in the last round had to be completed by no later than Fall of 2023. The analysis of all three tenders showed that in the first round of the "Hungary-Slovakia-Romania-Ukraine ENI CBC Program 2014-2020", only four projects were selected and none involved institutions of higher education.

In the second selection of 46 projects supported under the program, higher education institutions are involved in nine, of which eight are direct, and one through a structural division (Szabolcs-Szatmár-Bereg County Hospitals and the University Hospital). Regarding the territorial distribution of the institutions of higher education involved, universities from Romania participated in seven projects (Babes-Bolyai University, Technical University of ClujNapoca, Stefan cel Mare

University of Suceava, and the North University Center of Baia Mare), from Hungary, in six projects (Budapest University of Technology and Economics, University of Nyíregyháza, University of Miskolc and the Structural Division, University Clinic), from Ukraine, in seven projects (Uzhhorod National University, Ivano-Frankivsk National Technical University of Oil and Gas, and Institute of Geological Sciences of the National Academy of Sciences of Ukraine), and from Slovakia, in five projects (Pavol Jozef Šafárik University in Košice and Technical University of Košice). Our analysis of institutions of higher education also showed that the most projects were implemented with the participation of Technical University of ClujNapoca and Technical University of Košice (four projects each), Uzhhorod National University, Ivano-Frankivsk National Technical University of Oil and Gas, and University of Miskolc (three projects each), Babes-Bolyai University and North University Center of Baia Mare were involved in two projects, other universities were involved in one project (Pavol Jozef Šafárik University in Košice, Budapest University of Technology and Economics, Stefan cel Mare University of Suceava, and University of Nyíregyháza), as well as university units (University Hospital) and other scientific institutions (Institute of Geological Sciences of the National Academy of Sciences of Ukraine). The total fund for these nine projects amounted to €6,040,507; ten universities, two structural divisions of universities, and one research institution were involved.

In the third competition of the program "Hungary-Slovakia-Romania-Ukraine ENI CBC Program 2014-2020", out of 30 supported projects, higher education institutions were involved in six, of which one project was implemented by a structural unit of the university (University Hospital), one project was implemented exclusively by universities without involvement partners from the public sector or from the authorities (the "NSDNeuro" project with the participation of the State University "Uzhhorod National University" and the University of Debrecen with a budget of €763,757). A territorial analysis of the institutions of higher education involved shows that universities from Hungary were involved in three projects (two universities, University of Miskolc and University of Debrecen, and one university unit, University Hospital), from Ukraine, four projects (State University "Uzhhorod National University" and Ivano-Frankivsk National Technical University of Oil and Gas), and from Slovakia, two projects (Pavol Jozef Šafárik University in Košice and Technical University of Košice). Universities from Romania were not involved. Our analysis of institutions of higher education showed that largest number of such projects was implemented with the participation of the Uzhhorod National University (three projects), while other institutions implemented one project each (Technical University of Košice, Ivano-Frankivsk National Technical University of Oil and Gas, University of Miskolc, Pavol Jozef Šafárik University in Košice, University of Debrecen, and

University Hospital). The total funding for all projects amounted to €3,781,496. Six universities and one structural unit of a university were involved (The 3rd Call for Proposals n.d.).

The analysis of four competitions held within the framework of the programs "Hungary-Slovakia-Romania-Ukraine ENPI Cross-Border Cooperation Program 2007-2013" and "Hungary-Slovakia-Romania-Ukraine ENI CBC Program 2014-2020" showed positive dynamics. In the first program, two projects were supported with the participation of the university, while 15 projects were supported under the second program in three competitions. As a percentage of the total number of supported projects, under the program "Hungary-Slovakia-Romania-Ukraine ENPI Cross-Border Cooperation Program 2007-2013" with the participation of universities, 6.4 percent of projects were supported, and under the program "Hungary-Slovakia-Romania-Ukraine ENI CBC Program 2014-2020", 18 percent were supported. When comparing the two programs, the growth of projects involving the participation of institutions of higher education was 12 percent.

In a meaningful analysis of projects involving the participation of universities, digitalization creates conditions for their proper organizational and technical support, since first the COVID-19 pandemic and then the full-scale war in Ukraine made adjustments to the free mobility of various project participants—both the main performers as well as experts and beneficiaries. The use of various digital tools, including platforms and services for online collective communication, holding seminars and other events, made it possible to successfully implement the specified projects. At the same time, the directions and goals of projects between higher education institutions are diverse. For example, the project "Introduction of New Standards and Technologies of Surgical Treatment of Diseases of the Central Nervous System in the Cross-Border Region 'NSDNeuro'" with the participation of the State University "Uzhhorod National University" and the University of Debrecen (budget €763,757) provided for joint training for neurosurgeons using innovative neuronavigation systems purchased as part of the project, training for student and teaching youth, and health care specialists, which resulted in conducting exchange visits, forming new standards of medical care, and improving the material and technical base of both project participants (Departments of Neurosurgery of Debrecen University and Regional Clinical Center of Neurosurgery and Neurology in Uzhgorod) (Implementation of New Standards 2025).

The project "Cross-Border Network of Energy Sustainable Universities" (2020), which was implemented from October 1, 2019 to September 30, 2021, with the participation of Ivano-Frankivsk National Technical University of Oil and Gas (Ukraine), Technical

University of Košice (Slovakia), University of Miskolc (Hungary), Technical University of ClujNapoca, and North University Center of Baia Mare (Romania), aimed to overcome the effects of climate change through energy efficiency and sustainable development tools, including cooperation, support, and the exchange of experience. Among the key measures were the implementation of an educational and research site with real costs, the identification of bottlenecks (physical and IT infrastructure, management model), and the construction of a management system with IT solutions for online monitoring of energy consumption and losses by universities (Cross-Border Network).

The project "Regional Center for Training and Monitoring of the Environmental Impact of Electrical Installations", which was carried out in partnership by two universities, the North University Center of Baia Mare and the Ivano-Frankivsk Technical University of Oil and Gas (March 1, 2020–February 28, 2022), tried to solve the problem of environmental protection from various forms of negative impact of electricity in the cross-border territory. During the project, the following measures were identified: environmental education, conducting an information campaign on the impact of electricity on the environment through surveys and exchange of experience, including the identification of common elements and differences in systems for assessing the impact of electrical installations on the environment; the training of 120 students/masters (60 from each country) regarding the transboundary impact on the environment of production, transportation, distribution and use of energy; the formation of a joint information system on indicators of electromagnetic pollution, the impact of radiation, sounds and vibration of electrical installations in the cross-border region; and the development of cooperation between various organizations in this area (Regional Center n.d.).

In the project "Energy Recovery from Municipal Solid Waste by Thermal Conversion Technologies in the Cross-Border Region", which was carried out by the North University Center of Baia Mare, the Ivano-Frankivsk Technical University of Oil and Gas, and the Technical University of Košice from November 1, 2019 to October 31, 2020, the main goal was to bring together experts from prestigious universities to explore the possibilities of managing solid household waste through the thermal treatment method, as well as to raise awareness, create databases with waste characteristics, and develop a software application ("Electronic Monitoring Platform") for data management relating to the administration of heat treatment of waste (Energy Recovery n.d.).

As part of the project "Expansion of the Existing Space Emergency Protection System for Monitoring Dangerous Natural and Man-Made Geoprocesses in the Cross-Border Territory of Hungary, Slovakia, Romania, and Ukraine" (2025), implemented from December 2019 through May 2022, geodetic surveys were planned for

the cross-border territory, along with the development of a methodology for the use of existing infrastructure in spatial and temporal modeling of water vapor content in the atmosphere, and the formation of a risk map on a special platform. Five partners were involved in the implementation of the project: Uzhhorod National University (Ukraine), Pavol Jozef Šafárik University in Košice (Slovakia), Technical University of ClujNapoca (Romania), Budapest University of Technology and Economics (Hungary), and Szabolcs-Szatmár-Bereg (Hungary) (Expansion).

The project "New Energy Solutions in the Carpathian region", implemented from January 2020 through December 2022, aimed to promote energy efficiency and renewable energy sources through education and practical activities in communities for the sustainable use of natural resources in the border regions of Ukraine, Hungary, Romania, and Slovakia. The project's main activities included: raising awareness of environmental protection among residents of 12 communities from four border regions; developing the energy concept, including the use of renewable energy; conducting exercises and training sessions for the staff of the Energy Training Center and laboratories on energy efficiency and renewable energy; installing a system of solar panels and heat pumps for heating the premises and heating the water in the pool of the Burevisnyk sports complex; developing research on energy audits and energy management using new technologies and innovations for local communities and locations, etc. Six partners participated in the implementation of the project: Uzhhorod National University (Ukraine), Szabolcs-Szatmár-Bereg (Hungary), Stefan cel Mare University of Suceava (Romania), NGO "Center for European Initiatives" (Ukraine), Technical University of Košice (Slovakia), and Niredgaz University (Hungary) (New Energy Solutions 2025).

At the same time, a substantive analysis showed that no project was aimed at the development of digital technologies in the field of cross-border cooperation. The latest digital technologies have become tools for the implementation of individual projects (creation of platforms, websites, promotion of events, etc.), and also helped in the organizational aspects of project implementation, first during the COVID-19 pandemic, and later throughout the war in Ukraine.

## Conclusions

Modern risks caused by possible pandemics, hostilities, and other emergency situations urge increased digitalization of cross-border cooperation between institutions of higher learning in order to create a single expert online platform, including intergovernmental dialogue, the exchange of experience at different academic levels (between students, postgraduates, and teachers), the optimization of academic mobility,



and the simplification of the system of recognizing diplomas and confirming qualifications.

The priority areas of cross-border cooperation between institutions of higher education regarding the digitalization of education and scholarship are:

- inter-state dialogue and communications to improve the digital skills of participants in educational and scientific activities, as well as awareness of digital security;
- exchange of experience and development of best common practices in the implementation of blended learning;
- development and implementation of joint training courses in a mixed format (remotely, face-to-face through digital tools);
- guaranteeing accessibility in the field of higher education;
- improvement of the technical capabilities of educational and scientific research in border regions;
- development of joint concepts of cross-border digitalization of border regions, and based on them, development of plans for digital transformation of institutions of higher education;
- formation of ethical recommendations regarding the use of artificial intelligence and data in scholarly research and education;
- formation of unified platforms for international data collection, exchange of information on educational services in different states within the framework of cross-border territories;
- formation of unified electronic libraries and databases in border regions.

For the development and transformation of education and science in educational institutions of Ukraine, it is very important:

- 1) to regulate at the legal level the possibility of dual education with double diplomas, for obtaining education at two universities within the border territories (simultaneously at a Ukrainian university and an institution in the EU; currently such a process is not regulated at the legislative level);
- 2) to strengthen the capacity of universities to introduce digital technologies into the educational process and to participate in the preparation and implementation of cross-border projects for building digital infrastructure.

Thus, global digitalization can not only propel processes of cross-border cooperation at the level of institutions of higher education, but also can promote the unification of standards in the field of education based on common values, overcoming barriers caused by borders.

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