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European Integration as a Determinant of Digital Transformation of Physical and Mathematical Scientific and Educational Processes of Higher Education Institutions of Ukraine

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ABSTRACT

The study highlights the peculiarities of digital transformation of scientific and educational processes of Ukrainian higher education institutions in the context of European integration. The main aspects that reflect the ways of their implementation in terms of internationalisation of education and science, modernisation of the content and methods of teaching, and improvement of the quality of scientific research are identified and substantiated. It is established that in the era of digitalisation, European integration opens up broad prospects for higher education institutions to expand international cooperation with European universities and research institutions, exchange of knowledge and best practices, ensure the quality of education and research, increase the competitiveness of graduates in the European labour market, and strengthen the authority of Ukrainian science and education in the world.

Keywords: European integration, educational and scientific processes, Bologna Process, academic mobility, digitalisation, higher education institutions

1. INTRODUCTION

Ukraine's aspirations for equal, competitive and full-fledged functioning in the European space have made significant adjustments to the main spheres of public life. The processes of European integration are increasingly affecting the education sector. International relations, cross-border cooperation, the Bologna Process, and scientific and technological innovations have led to a change in the concept of higher education and science development in Ukraine. Educational and scientific transformations are taking place in the context of European integration and rapid digitalisation. The current paradigm is aimed at internationalising physical and mathematical education and science, improving the quality of educational services and conducting research in the digital age. Accordingly, today's challenges require a rethinking of the guidelines for personal development, broadening of the worldview, and obtaining quality education to ensure competitiveness and successful self-realisation in future professional activities. It is higher education institutions that are the main link in the system that responds to social demands and creates conditions for the professional training of future specialists capable of making breakthroughs in the most important industries and spheres of public life, with a humanistic way of thinking and universal knowledge, capable of solving production and scientific problems in close connection with the tasks of preserving and enriching human values[1].

2. DEVELOPMENT OF DIGITAL TRANSFORMATION OF SCIENTIFIC AND EDUCATIONAL PROCESSES IN THE CONTEXT OF EUROPEAN INTEGRATION

European integration has become a key determinant of a number of transformation processes that reflect the current state and future development of physical and mathematical education and science in Ukraine. These include the harmonisation of educational standards and qualifications, internationalisation of education and science, modernisation of content and teaching methods, reform of governance and funding, and improvement of the quality of research. Here is a brief description of each of them.

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Ukraine's accession to the Bologna Process, which aims to create a single European higher education area, was the first step in shaping the modern paradigm of higher education. The principles of the Bologna Process, which have been actively and practically implemented, include the introduction of a multi-level education system that is consistent with the format of the multi-level system of higher physical and mathematical education in European countries. Accordingly, in higher education institutions of Ukraine, the professional training of future specialists includes a three-cycle system of education: bachelor's degree, master's degree, and doctorate/philosophy degree. The three-cycle education system ensures the comparability of qualifications and facilitates academic mobility. To ensure the transparency of curricula and facilitate the recognition of periods of study in other European institutions, the European system of credit transfer and accumulation has been introduced. Of particular importance is also the European Diploma Supplement, which reflects standardised information about the qualification obtained, facilitates its understanding and recognition abroad.

A strategic priority of the Bologna Process is the quality assurance system of higher education. In this regard, higher education institutions have implemented internal and external quality control mechanisms that meet European standards. However, the National Agency for Quality Assurance in Higher Education is a permanent collegial body authorised to implement the state policy in the field of quality assurance in Ukraine. Its strategic goals are aimed at gaining full membership in the European Association for Quality Assurance in Higher Education (ENQA) and inclusion in the European Quality Assurance Agency Register (EQAR), improving the system of external quality assurance in higher education, and encouraging innovative practices in higher education institutions in the interaction of research, education and business.

A characteristic feature of European integration is the internationalisation of education and science. Academic mobility contributes to the expansion of exchange programmes for students, teachers and researchers with European universities in order to gain knowledge, experience, practice, develop communication and language competencies, personal development and self-realisation. Ukrainian higher education institutions are active participants in one of the largest special programmes, Erasmus+, which offers educational mobility in the European Union. Academic mobility covers a number of complementary processes, in particular:

1) joint educational programmes and double diplomas (development and implementation of joint educational programmes with European universities, which allows students to obtain qualifications recognised in Europe);

2) attracting foreign students and teachers (creating favourable conditions for foreigners to study and teach in Ukrainian higher education institutions, which promotes cultural exchange and raises the profile of universities internationally);

3) participation in international research projects and programmes (enhancing the participation of Ukrainian scientists in European research initiatives, which contributes to the integration of Ukrainian science into the European research area).

The modern development of European societies is accompanied by serious challenges. In Ukraine, in the context of searching for answers to the challenges of our time and taking into account the laws of development common to European countries, the process of finding the most appropriate competence model for national education is underway [2]. Accordingly, a modern specialist, regardless of the field of activity, should not be a carrier of theoretical knowledge, but a practitioner, possessing such skills, abilities, and communication abilities that will contribute to solving complex professional problems, resolving unpredictable and non-standard situations at work. After all, as L. Tarhan points out, theoretical in nature and encyclopaedic in breadth, which have long been the main goal of the educational process, are now becoming a means. And the national higher education needs to shift the emphasis from a knowledge-based to a competence-based approach to education[3]. European integration processes have led to the modernisation of the content and methods of teaching, which are characterised by:

1) focus on the formation of key competences (literacy, language, mathematics, digital, personal, social, educational, civic, entrepreneurial, cultural awareness and self-expression);

2) introduction of innovative pedagogical technologies (information and communication, interactive, project-based, distance learning, case studies, etc;)

3) development of critical thinking and autonomy of students in acquiring knowledge (activation of students' work in the educational process, development of internal potential, formation of the ability to learn and make decisions independently);

4) integration of European values and standards (expanding the curriculum to include issues of European integration, human rights, democracy, sustainable development, etc.)

Ukrainian higher education institutions are gradually but surely adopting the standards and main principles of the European approach to learning and teaching, thereby improving the national higher education system. Together with their European colleagues, Ukrainian scientists, teachers and students are moving towards new achievements in the development of higher education[4].

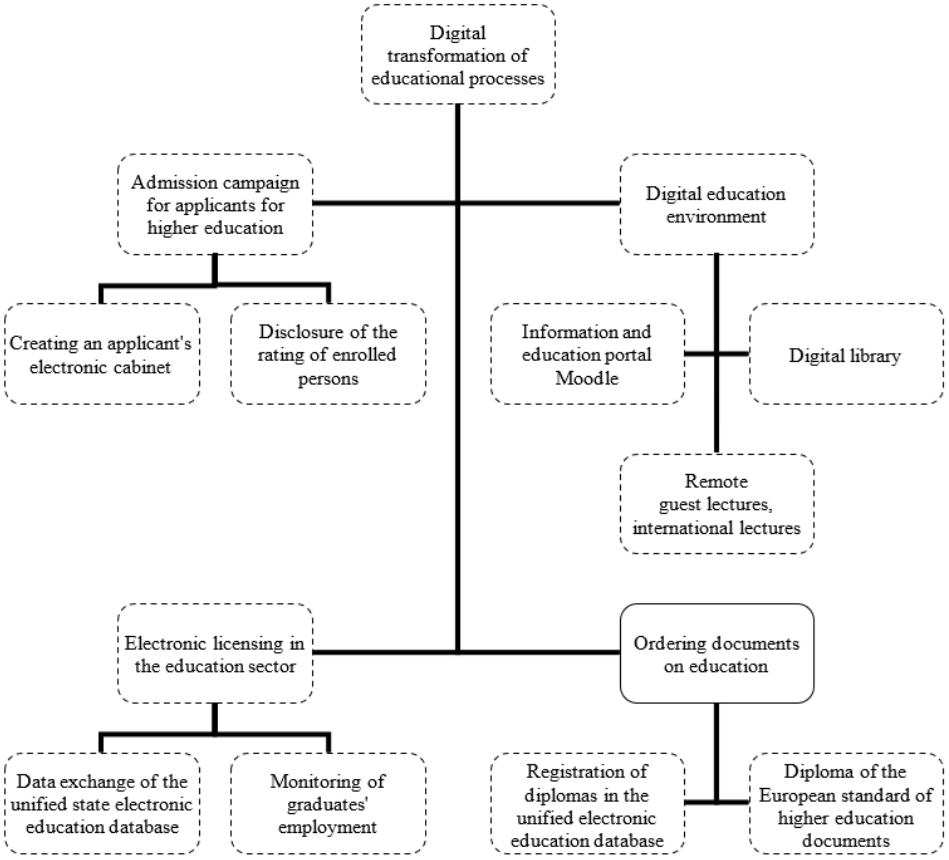

Figure 1. Digital transformation of the educational process

Under the influence of European integration, the management and financing of higher education is also being reformed, in particular:

1) autonomy of universities (granting greater independence in decision-making on the organisation and implementation of the educational process, research, financial activities, and personnel management);

2) ensuring transparency and accountability (implementation of effective management and control systems, ensuring openness of information on the activities of higher education institutions);

3) diversification of funding sources (attraction of funds from various sources, including the state budget, grants, international programmes, private investments);

4) development of strategic partnerships with employers (ensuring that programmes meet the needs of the labour market, establishing cooperation with European enterprises and organisations).

European integration opens up prospects for the development of science, improving the quality of research by stimulating publication activity in international scientific journals, modernising scientific infrastructure, promoting interdisciplinary research, and ensuring academic integrity.

Digitalisation plays a special role in the implementation of scientific and educational processes in the context of European integration. The use of modern information and communication technologies at all levels allows us to achieve

the predicted results. After all, the digitalisation of the educational process is a two-component system. On the one hand, it involves the introduction of advanced digital technologies for organising the educational process in higher education institutions. On the other hand, it involves the creation of knowledge banks and databases to improve the process of administering the organisation and provision of educational services[5].

The digital transformation of educational and scientific processes in the context of European integration is illustrated below.

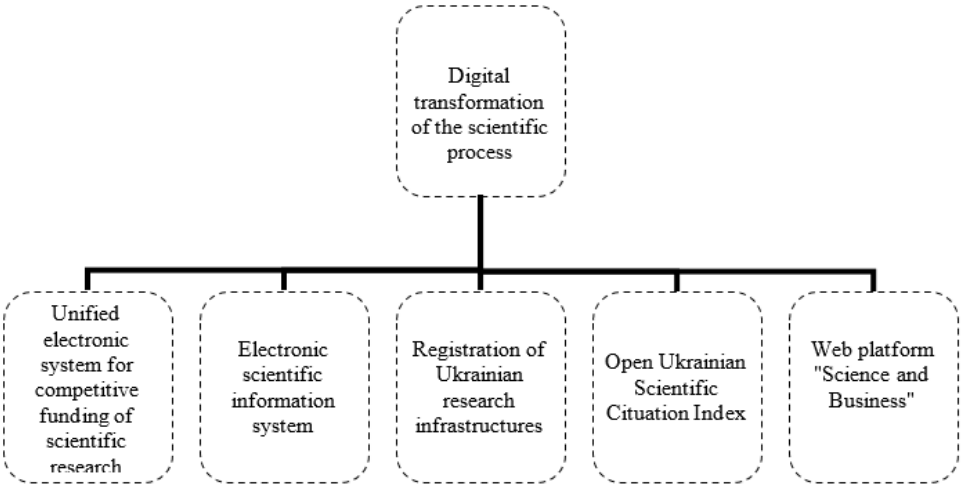

Figure 2. Digital transformation of the scientific process

In the context of European integration, the scientific and practical trends of digitalization development are manifested in a number of key directions that shape the modern educational space. These include the implementation of STEM education, which integrates natural and technical sciences to foster innovative thinking and professional competencies[6-9]. An essential component of this process is the advancement of technologies for designing complex optical and geometric structures[10-11], the application of modern methods of optical visualization[12] and analytical data processing[13-14]. Significant potential is also demonstrated by computer modeling systems employing visual data[15-19], which open new opportunities for integrating engineering and pedagogical approaches into the training of future professionals.

Particular attention should be paid to the use of Educational Data Mining (EDM) in professional practice[20-22]. The application of EDM methods contributes to improving the quality of the educational process by revealing hidden patterns in learners' activities, predicting their achievements, and shaping individualized educational trajectories. At the same time, the effectiveness of integrating these technologies largely depends on the level of foreign language proficiency, since access to leading scientific sources, international databases, and digital platforms is primarily provided in English.

Therefore, foreign language competence should be regarded as an integral component of the professional training of modern specialists[23-28]. It not only ensures participation in international scientific and educational projects but also fosters the ability for intercultural communication, which is a crucial factor in integration into the European and global educational space.

3. IMPLEMENTATION OF THE DIGITAL PROJECT DIGIN NET2

The DigIn.Net2 project of the German-Ukrainian Innovation Centre reflects the main features of the digital transformation of educational and scientific processes in the context of European integration. This project is aimed at implementing the ideas of students and young researchers from Ukrainian higher education institutions at the Anhalt University of Applied Sciences and creating a transnational network of scientists working on innovative ideas. In 2021, Volodymyr Hnatiuk Ternopil National Pedagogical University became a member of a consortium of five universities implementing the German-Ukrainian project DigIn.Net2: Deutsch-ukrainisches Netzwerk Digitaler Innovationen-2,

supported by the German Academic Exchange Service DAAD, 'Supporting the Internationalisation of Ukrainian Universities: Shaping the Digital Future Together'. Its goal is to strengthen digital competence at partner universities, modernise teaching and research, internationalise, and promote academic mobility. The main components of the project are a competition of innovative ideas, an international internship 'Digital future: Blended learning', and the Workshop. The digital project opens up a wide range of opportunities, including academic mobility, internships based on an individual programme, a discount on publication in the ICA Proceedings journal, which is indexed in Scopus, etc.

4. SYMMARY

In view of the above, European integration can be seen as a determinant of the transformation of educational and research processes in Ukrainian higher education institutions, which involves the alignment of policies, institutions and systems with European standards and experience. This can lead to improved quality of education, research and international cooperation. It is important that European integration contributes to the transformation and modernisation of research and education processes in higher education institutions.

European integration is a powerful catalyst for positive changes in Ukraine's education and science sector, aimed at its integration into the European education and research area. This process requires joint efforts from the state, higher education institutions, researchers, teachers and students, and its successful implementation will be a key factor for the future development of Ukraine as a European state.

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