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DIGITAL TRANSFORMATION OF THE LEARNING ENVIRONMENT AT UNIVERSITY

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Abstract: *One of the ways to develop the digital competence of future teachers is to create a digital learning environment at university. The article substantiates the essence of the concept of "digital educational environment", defines its structural components and outlines strategies for its implementation. The article analyses foreign experience in the creation and implementation of digital learning environment, which is a critical component of the model of the development of future teachers' digital competence. An important precondition for creating a digital learning environment of a university is the availability of modern IT infrastructure, technologies and means of electronic communication of all the participants of educational process, the creation of digital educational content. In this context, the experience of Volodymyr Hnatiuk Ternopil National Pedagogical University on the digital transformation of the educational process is shared. The article describes the principles of projecting digital learning environment. It analyses possibilities of the organisation of the digital learning environment of a university with the use of cloud technologies and their possible application in various fields, which provides a range of opportunities for the digitalization of educational process.*

Keywords: digital transformation; digital competence; digital technologies; digital learning environment; communication, collaboration.

INTRODUCTION

Nowadays, digital transformation is a popular trend which influences all spheres of public life. Modern higher educational institutions seek to provide training for highly

qualified professionals with developed professional competencies that are in demand on the labour market. Modern young generation Z requires non-standard approaches to the organization of educational process. One of the possible ways of achieving these goals is digital transformation of the educational environment of a higher educational institution which is a platform for the development of modern methods and innovations. The digital transformation of educational environment means its modernisation and reformation with the help of digital technologies. The digital learning environment of a higher educational institution should ensure the development of the digital competence of future professionals through the widespread use of digital technologies and the introduction of new innovative methods and solutions.

Methods

To achieve the goal, a set of methods was used:

- theoretical: methods of the comparative analysis of scientific sources for understanding the state of the research problem, for determining the conceptual apparatus of the research, synthesis, generalization, systematization for theoretical justification of the principles of designing a digital learning environment of a higher educational institution;
- empirical: the study of strategies, regulations for designing a digital learning environment.

1. BACKGROUND RESEARCH

The digital transformation of education and the rapid development of digital technologies require higher educational institutions to change their approaches to the organisation of the educational process. Today, a higher educational institution must train competitive specialists for the labour market, who must be able to demonstrate professional competencies.

Today, the digitalisation of education in accordance with national and European programmes and frameworks occurs in Ukraine: "Ukraine's Digital Agenda – 2020", which includes initiatives, projects, basic principles of the digitalization in Ukraine until 2020, the European Digital Competence Framework (DigCompOrg, 2015), European Digital Competence Framework for Educators (DigCompEdu, 2017). In 2019, by the order of the Ministry of Education and Science of Ukraine, a working group developed a description of teachers' digital competence, which contains requirements for the structure and the levels of digital competence necessary for teachers' successful professional activity in the conditions of digital society development. In 2020, the Ministry of Education and Science of Ukraine developed a professional standard for teachers of general secondary educational institutions, which sets requirements for teachers in accordance with the qualification category. The standard describes the professional competencies of a specialist. Information and digital competence is one of the key competencies of a teacher.

Various aspects of education informatization have been the subject of research of many Ukrainian scientists. Thus, Morze and Spivak substantiated the ICT competencies of students and their ability to use information and communication techno-

logies to carry out information activities in their professional field (Morze, Spivak, 2017). The scientists have considered the features of the formation of a modern cloud-based personalized learning environment, taking into account students' ICT competence. Henseruk substantiated the essence of the concept of *digital competence* and identified the components of *digital competence* of future teachers, outlined the directions of its development in the conditions of the digital transformation of the educational environment of an educational institution (Henseruk, 2019). Panchenko has developed a theoretical and methodological basis for the development of the information and educational environment of a university (Panchenko, 2010). Vakaliuk proposed a model of a cloud-based support system for teaching bachelors in Computer Science, in which students, teachers and administrators are the subjects of interaction (Vakaliuk, 2016). Many researchers state that the creation of information and educational environment in educational institutions involves: prompt updating of educational information; qualitative change of methods and forms of educational activity; obtaining information about the level of academic achievement of each student, making adjustments to teaching methods; students' ability to control the quality of the knowledge they acquired (Smyrnova-Trybulska, 2018; Morze, Kocharyan, 2014; Bykov & Shyshkina, 2016; Spirin, 2009; Balyk & Shmyger, 2017; 2018).

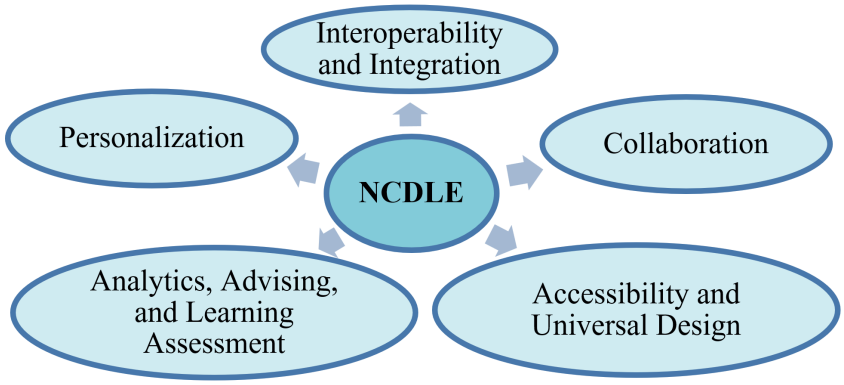
Despite various studies existing, the problem of the digital transformation of the educational environment of higher educational institutions, which will ensure the development of future teachers' digital competence, requires a more detailed study.

2. FOREIGN EXPERIENCE

The problem of designing and creating a digital learning environment is studied by many foreign scientists. In 2014, the Bill & Melinda Gates Foundation, with the support of EDUCAUSE, began exploring modern learning management tools and creating a digital learning environment that can meet the changing needs in higher education. As part of these studies, EDUCAUSE conducted a series of interviews with experts in order to get the idea of the possibilities of existing tools and to find the idea of designing new learning environments.

According to scientists, the next generation digital learning environment (NGDLE), which will become an ecosystem and a digital learning platform for all the participants of the educational process, should be designed in educational institutions. This environment contains a wide range of training programs and digital educational services, quality management tools for education as well as enables communication, data exchange and digital content. For users, it is a cloud storage for identifying and connecting content and features, similarly to a smartphone, where users modify their environment directly with the help of applications selected by them. All the software and educational resources must be located in one place and should implement all the functions of a digital university.

NGDLE has to provide support for the educational process and perform the following functions (cf. Figure 1) (Brown, 2017):



F i g u r e 1. Functions of the digital learning environment of the future generation

S o u r c e: Own work.

All of these functions are NGDLE dimensions which are interconnected. The design and the development of the next generation digital learning environment is possible only if all the functions are implemented.

Scientists have developed a model of the next generation digital learning environment which includes 13 components that are interconnected and aimed at implementing the functions mentioned above:

The proposed NGDLE is an ecosystem that contains a wide range of programs and digital services. One of the key tasks in the implementation of the next generation digital learning environment is full compliance with standards and support of the educational process.

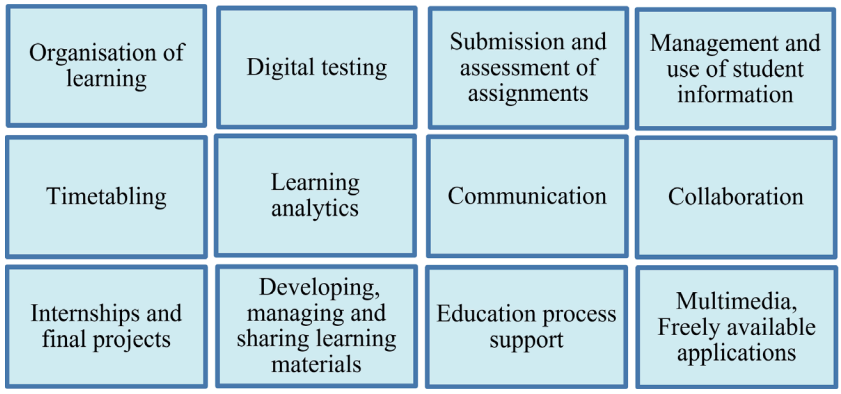
Dobbin believes that the main focus of NGDLE should be on students (Dobbin, 2016). The next generation digital learning environment will promote the use of new innovative forms of learning, the adaptation of methods and digital tools for the educational process support. According to the author, the key functions of NGDLE are: Communication, Inclusion, Collaboration.

The successful functioning of the digital learning environment depends on the use of special software that makes it possible to integrate various resources, improve their functionality and provides data protection. Researchers from various US universities (Goodrum et al., 2019) propose new standards for the implementation of learning tools – Learning Tools Interoperability (LTI) Advantage.

LTI Advantage is the next generation of learning tools designed to integrate learning applications and tools into the digital learning environment of an educational institution. LTI Advantage contains three extensions that make it possible to quickly set various configurations, improve user functionality, increase security and students' data protection. LTI Advantage contributes to the improvement of the digital ecosystem of the educational institution, the integration of digital resources, programs and educational applications into the course. This software allows the platform to validate credentials and share data in the context of teaching and learning, helps to preserve the data of the educational process participants, makes the process of the enrollment on a course faster and automates the assessment process. LTI Advantage

reduces technological barriers for students and teachers, reduces the amount of time needed for a course development. The tools and digital content implemented by LTI Advantage make the content of a course scientific and creative. The use of LTI Advantage expands an educational institution's ability to effectively use digital learning resources, programs and tools implementing the functions of the next generation digital learning environment (NGDLE).

The Dutch National Research and Education Network (NREN) SURFnet represented by researchers from higher educational institutions and research institutions aims at researching opportunities for the education quality improvement by supporting innovations and enhancing the usage of information and communication technologies. One of the issues alike is the design of the digital learning environment for a higher educational institution. Marieke de Wit and Herman van Dompseler outline the components of a modular digital learning environment (cf. Figure 2). Some components are available to all the students and teachers of an educational institution, while others require authorization. The components must be interchangeable and should be constantly improved so that the learning environment will be always adapted to the latest innovations in education and technological innovations.



F i g u r e 2. Components of the digital learning environment of a higher educational institution

S o u r c e: Own work.

Organization of learning is a component which provides clear and simple access of students to the content and applications necessary for their studies, the distribution of students in groups, the authentication of students (groups of students) and access management. Organization of learning is a key aspect of the learning management system in the digital environment.

Digital testing improves the quality of teaching, learning and testing in education. There are four subcomponents of this element: an author environment, a playback environment, an analysis tool and an item bank.

Submission and assessment of assignments. This component provides a link between students and teachers (providing student feedback, grades, notifications about the grades and opportunities for their appeal as well as checking for plagiarism).

The *management and use of student information* involves both managing students' administrative data (e.g., personal data) and the registration of grades, academic progress and attendance.
Timetabling provides an opportunity for time and resource allocation in various directions by teachers and students.
Internships and final projects. Internships and final projects are a part of all the curricula in higher educational institutions in the Netherlands. This component provides a link between the internship institution and the students manages contracts and documentation as well as monitors the quality of the internship programme.
Developing, managing and sharing learning materials. This component provides the implementation of the functional possibilities for the development, management and exchange of educational materials.
Education process support. It involves the use of digital tools for monitoring student performance and learning as well as feedback with the aim of supporting the learning process.
Learning analytics. The learning analytics component refers to the programs that gather and analyse information about students' learning process in order to understand and improve teaching and learning processes.
Communication is one of the key components of the digital learning environment.
Collaboration. The digital learning environment should offer ample opportunities for encouraging collaboration in a variety of ways (interinstitutional collaboration, distant collaboration, feedback assessment, and learning content sharing).
Multimedia, freely available applications. This component provides an opportunity to attend lectures remotely in real time, enables students to create videos for completing their tasks. Programs that are freely available make it possible to constantly add new tools to the digital learning environment.

3. THE DIGITAL LEARNING ENVIRONMENT OF TERNOPIL VOLODYMYR HNATIUK NATIONAL PEDAGOGICAL UNIVERSITY

Digital transformation of the learning environment of an educational institution is a complex, long and laborious process which must be ensured by the coordinated work of all the structural units of a university, highly qualified IT specialists, teachers and students. Digital technologies must be integrated into all the sections of educational infrastructure. An important factor of designing and implementing digital learning environment is the availability of modern IT infrastructure of a higher educational institution.
Ternopil Volodymyr Hnatyuk National Pedagogical University (TNPU) has extensive experience in building a single integrated IT infrastructure, the creation and the operation of which began in 1999. IT infrastructure of TNPU has many levels, which include technical level, program-informational level as well as organizational and methodical level. A modern system of server technologies was created on the basis of Ternopil Volodymyr Hnatyuk National Pedagogical University in order to ensure the functioning of the university, user management, of users' data storage, access to databases, file servers, updates for anti-virus databases, software and mail server. The IT

infrastructure of TNPU is the core of SMART-TNPU, which ensures the functioning of all its structural components.

According to the trends that determine the development of modern education system, educational environment of a university should be based on the use of modern IT solutions and digital technologies. Therefore, one of the key components of SMART-TNPU is the digital learning environment, the design and the operation of which is implemented by using a system approach which is based on the approved conception and a single architecture.

For the effective digital transformation of the learning environment, the Centre of the Learning Environment Digital Transformation has been established at the university. The main purpose of the Centre is to study and implement modern strategies for the development of the digital learning environment of the university as one of the key components of SMART-TNPU; the development of the digital competence of teachers and students at the university, organizational and methodological support in the integration of digital technologies into the educational process by the departments of the university.

The design of the digital learning environment of TNPU was carried out in compliance with the following principles.

- the priority of the implementation and the system integration of digital technologies;
- the principle of feedback availability;
- openness, accessibility and innovation;
- systemic structure, the creation of new structural subdivisions for the functioning of the environment components;
- personal access and professional development of all the participants with the help of digital technologies;
- organizational structure variability in accordance with the educational policy of Ukraine in the sphere of higher education;
- the improvement of teaching quality and enhancing the efficiency of the educational process organization.
- In the age of digitalisation, information is an intellectual property. Therefore, information storage and processing systems are subject to increased requirements for reliability, processing speed and storage security. One of the key components of the digital learning environment is the creation of a single database of students and teachers in compliance with these requirements.

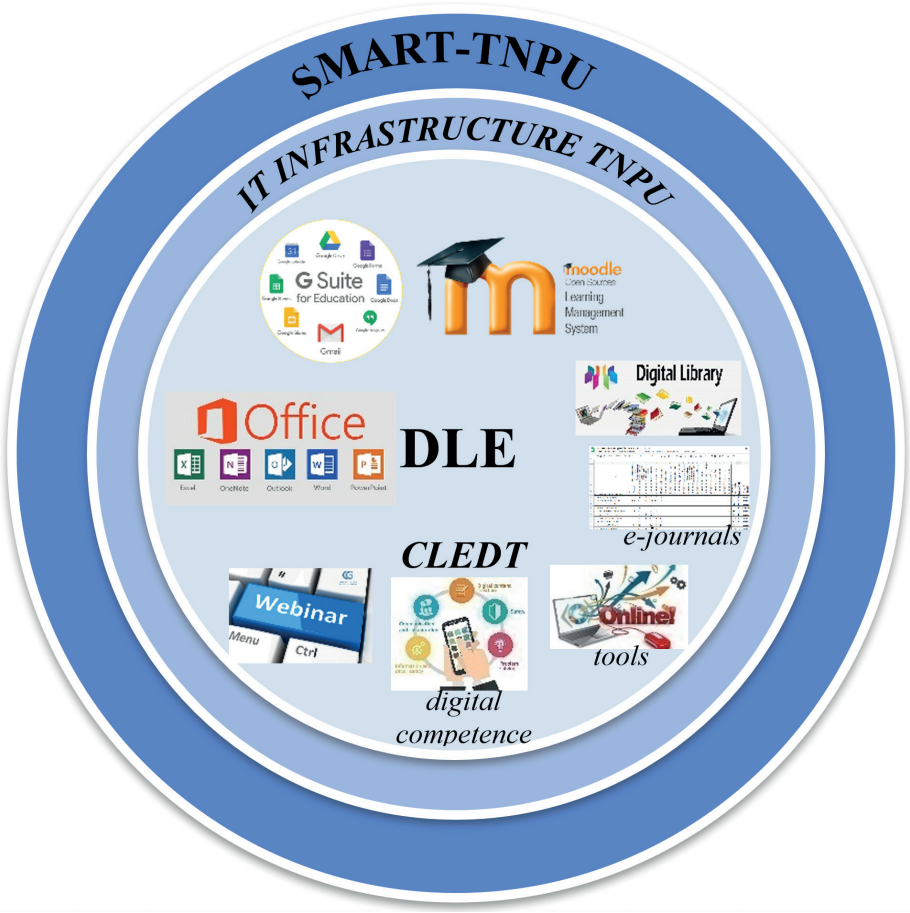
Recently, there has been an increased interest of scientists in cloud technologies as a means of making education easily accessible and mobile, ensuring the continuity of the educational process and the shared access of all the participants to digital educational resources. The organisation of the digital learning environment of the university with the use of cloud technologies makes it possible to effectively use online services in order to provide the students with modern educational resources.

The components of the virtual component of the digital learning environment of TNPU are divided into two groups: specialized solutions (LMS) and separate online services, which, when used as a whole, provide solutions to basic problems, includ-

ing the development of the specialists' digital competence (cf. Figure 3). For the remote interaction of the teachers and the university administration with the students, such solutions as groups, mailings, joint work with documents, the creation of questionnaire forms, results processing, e-journals and interactive whiteboards are used. Access to resources is unified due to a single authentication system implemented at the university. The basis of the authentication is the LDAP directory and the LDAP protocol.

All the electronic courses at Ternopil Volodymyr Hnatiuk National Pedagogical University were created in Moodle. After the first authentication of a user in Moodle, an account is automatically created in its own database. E-courses contain digital content (video lectures, practical tasks, presentations), tests and provide feedback.

In 2016, the university created a corporate Google email with the domain tnpu. A Google account allows each student and teacher to use the G Suite for Education web services for work and interaction.



F i g u r e 3. Virtual component of the digital learning environment of TNPU

S o u r c e: Own work.

TNPU – Ternopil Volodymyr Hnatyuk National Pedagogical University DLE – digital learning environment, CLEDT – Centre of the Learning Environment Digital Transformation.

Teachers and students of TNPU also have access to Microsoft products (Office Web Apps): the opportunity to download, edit directly in the browser and to save as a cloud document files in the following formats: Word, PowerPoint, Excel, OneNote. In addition, there is an opportunity of joint work on the created files.

The digital learning environment of TNPU makes it possible to solve the following tasks:

- integration of the university into the global learning environment;
- extensive use of digital technologies in teaching and learning;
- using quality educational and scientific content in various forms in the learning and teaching processes at the university;
- providing reliable and quick access to various sources of information;
- the development of a platform for e-learning;
- ensuring on-line monitoring of current processes with the help of an electronic accounting system in order to ensure the validity and quality of management decisions;
- the development of the digital competence of teachers and students;
- ensuring the accessibility and openness of education;
- increasing the university ranking on the global education market;
- encouraging student mobility and increasing their competitiveness.

The effective functioning of the digital educational environment of TNPU is ensured due to the connections between its components.

CONCLUSIONS

The digital educational environment of an educational institution makes it possible to implement in the most effective way the services that a university should ensure to provide its students with modern educational resources. For the design and the successful development of the digital learning environment, modern IT infrastructure must be created at the educational institution.

The created digital learning environment of a university will make it possible to combine technology and all the participants of an educational process within a single system, which will improve the quality of education, enable the development of students' digital competence and training of highly qualified specialists who are in demand on the modern labour market.

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