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EDITORS

Serhiy Semerikov
Viacheslav Osadchyi
Olena Kuzminska

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2nd Myroslav I. Zhaldak Symposium on
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Edited by Serhiy Semerikov, Viacheslav Osadchyi and Olena Kuzminska

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- Massive open online courses
- Methodology of informatization in education
- Methods of using cloud-oriented learning tools
- Mobile and blended learning
- Mobile technology of augmented reality
- Modelling systems in education
- Open learning systems and virtual conferences for training professionals
- Psychological safety of participants in the educational process in the digital educational environment
- Seamless learning and holistic education modelling and design
- STEAM education
- Supporting the development of 21st century skills through ICT
- Training and professional development of specialists in the digital twin of the educational institution
- Training of managers of a socio-political profile in the context of society digitalization: a humanistic aspect
- Virtualization of learning

This volume represents the proceedings of the 2nd Myroslav I. Zhaldak Symposium on Advances in Educational Technology, held in Kyiv, Ukraine, on November 11-12, 2021. It comprises 65 contributed papers that were carefully peer-reviewed and selected from 200 submissions. Each submission was reviewed by at least 3, and on the average 3.1, program committee members. The accepted manuscripts provide an up-to-the-minute appraisal of successful cases and delineate guidelines for prospective research.

We express our gratitude to all the scholarly authors who submitted their works and the participants who graced the occasion with their presence and interest in AET as a platform for sharing their ingenious ideas. We are profoundly grateful to the program committee members for their unwavering guidance, while the peer reviewers, by offering constructive criticism, commendations, and corrections, have tremendously contributed to the quality of the publications. We extend our appreciation to the developers of HotCRP, whose exceptional conference management system provided us with a wealth of resources, from the call for papers and reviewer invitations to handling paper submissions and communication with the authors. Lastly, we acknowledge the SCITEPRESS team for their cordial and fruitful cooperation in assembling and publishing the symposium proceedings.

Editors
Serhiy Semerikov
Viacheslav Osadchyi
Olena Kuzminska

CONTENTS

PAPERS

FULL PAPERS

Digital Transformation in Education: Model for Higher Educational Institutions

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Keywords: Digital Transformation, Digital Transformation Model, Digital Transformation of Education, Higher Educational Institution.

Abstract: The paper is devoted to the analysis of the digital transformation processes that are currently taking place in education. Present research based on previous authors research that considered the some aspects of development a generalized digital transformation model. The research analyzes approaches to developing a model of digital transformation of education. In addition, the ways of its implementation are determined. Besides that, the generalized model of digital transformation of education is proposed. According to the results of the research, the model of digital transformation of the higher education institution was developed. In response to the impact of digital transformation, it can be used as a roadmap for solutions for the digital transition to an innovative model for the functioning of the modern university.

1 INTRODUCTION

The digital technologies have become a part of our modern everyday life: artificial intelligence, robotics, IoT, blockchain and 3D technologies, etc.

The use of digital technologies is transforming business models, resulting in new products and services; the format of works is changing (outsourcing, online platforms, improved automation, robotics, etc.). Real-time work with digital data fundamentally changes the ways of management, production, sale and use of products (Vishnevsky et al., 2020).

The report of the consulting company Accenture (for 2017) identifies five new digital technologies that can transform global economic development (Ford and Lobo, 2017): Internet of Things (IoT), Artificial Intelligence (AI), Blockchain, Big Data, Robotic Process Automation (RPA).

Thus, modern digital technologies, services and systems are extremely important for social development. Their introduction into the activities of enterprises and organizations, engineering and technology, production and non-production processes allows to expand the range of goods and services, improve their quality and compliance with consumer demand, increase productivity and form new value-added chains. This will ensure growth and creation of jobs in all economy sectors (from the smallest traditional enterprises to the latest high-tech industries).

However, the education system is failing behind the general state of digital transformation in society. In our opinion, the main problem is the lack of understanding by the participants of the educational process of the institutions (higher, secondary and vocational) what is the difference between the use of digital technologies and innovations provided by the transformational changes that digital technologies bring to the educational process, and comprehension of concepts, structure, required and sufficient conditions and processes of digital transformation in general and in education in particular.

Paper goals. The purpose of this research is to analyze and develop model of digital transformation model of education and digital transformation model of higher education institution.

2 RESEARCH METHODS

The authors have used the following research methods and tools for the investigation (2021-2022).

Quantitative methods: 1) scientific monographs;

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2) research papers; 3) study and analysis of documents about digital transformation; 4) analysis approaches for development digital transformation model, also in educational field; 5) (online) meetings, (video) conferences, seminars, workshops, etc.

Qualitative methods: survey and interview of the Ukrainian educators to determine their awareness about digital transformation of education.

3 THEORETICAL BACKGROUND

Digital transformation is the use of digital technologies (Negroponte, 1995) to fundamentally increase the productivity and value of enterprises (Westerman et al., 2014). Now this is the focus of managers and employees of actively competing industries around the world. Digital transformation is due to the use of rapidly developing digital technologies and their accelerated impact on society. Such transformation takes into account the changes that have already happened, happening and will happen in the future (i-SCOOP, 2021). The processes of digital transformation are affecting many areas of human activity. They are felt in all areas where there is mechanization and automation of data processing.

Figure 1 shows the areas in which fundamental changes are expected due to the digital transformation.

Digital transformation (DT) is the result of digitisation and digitalization of economies and societies. DT is an ongoing process. The introduction of digital technologies creates both new opportunities and new challenges.

Consider the challenges posed by a process, digital transformation, which is a complex phenomenon of different development. These challenges are related to the following issues:

- which areas are most affected by the digital transformation;
- how the digital transformation affects the labor market, training of future professionals, and social life in general;
- what are the ways to implement digital transformation for different industries;
- what steps need to be taken for the digital transformation of companies, production, ecosystem, and a particular industry as a whole;
- what changes in educational systems need to be made to adapt people and accelerate their inclusion into the processes of digital transformation.

One of the key issues for the implementation of digital transformation is changes in the way of thinking and requirements for the competencies of workers in the industry. First of all, it is connected with people's understanding of digital transformation processes and with their ability to use digital technologies effectively.

Our previous research focused on development of the digital transformation model (Morze and Strutynska, 2021). Based on the analysis of the considered researches (Pawlowski, 2019; Mergel et al., 2019; Bumann and Peter, 2019; Rof et al., 2020; Muluk, 2016; Patton and Santos, 2018; Wildan Zulfikar et al., 2018; Nguyen, 2018), the authors of this paper proposed a general model of digital transformation (figure 2).

The main components of this model are:

1. The reasons that lead to the need in digital transformation of the area/industry (the impact of digital technologies, new services, new requirements to life in a digital society, etc.).
2. The use of digital technologies to change business processes in the industry to increase its efficiency.
3. Preparation of workers, employers, the population as a whole for life in new socio-economic conditions (change of culture, way of thinking, abilities, skills, and mutual relations) and development of their digital competences.
4. Effective use of existing data, including the use of modern tools for their analysis with elements of Artificial Intelligence and Big Data.
5. The main results of digital transformation include new products, services, policies, markets, environment and development of the digital society as a whole.

4 DIGITAL TRANSFORMATION IN EDUCATION: IMPLEMENTATION APPROACHES

In the conditions of intensive development of digital technologies, digitalization, digital transformation of many branches of human activity, fast change of professions demanded in the labor market and, accordingly, professional requirements to competences of experts, educational activity needs updating of the maintenance and methods of training, search for innovative forms of training, expanding access to educational resources, and the implementation of learning

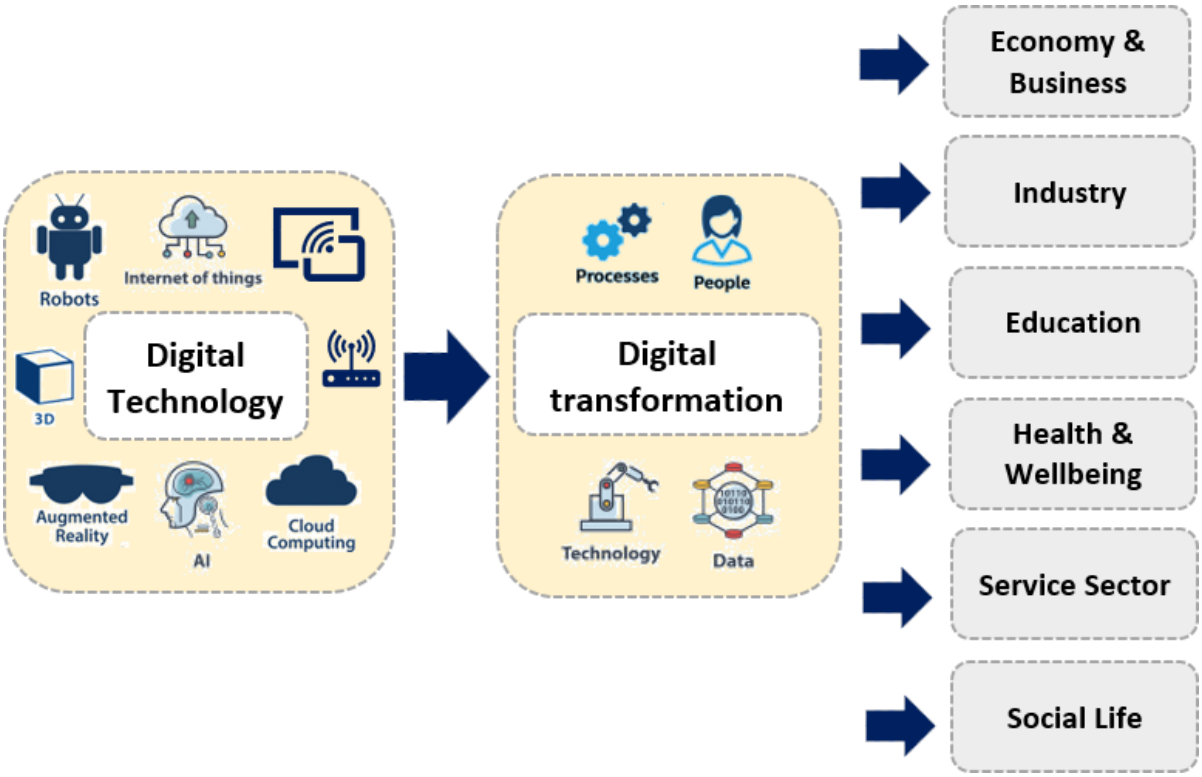

Figure 1: Areas in which fundamental changes take place due to the digital transformation (Morze and Strutynska, 2021)

opportunities without space- and time-based restrictions, the introduction of new approaches to the organization of educational services in general. Thus, the digital transformation of education is an integral part of the processes taking place in society today.

Technologies play a key role not only in enabling new ways of teaching and learning, but also in new business models required to drive the very transformation that educational institutions are trying to effect (Patton and Santos, 2018).

Digital transformation means a qualitative increase in the effectiveness and productivity of educational activities through:

- changes (updates) of goals and content of educational activities;
- review and optimization of teaching materials and organizational solutions, tools and services used in educational activities;
- updating the organization and methods of educational activities, focusing on maximizing the potential of each student, the transition from learning and educating of all to learning and educating of everyone (personalized learning);
- review of traditional business processes, inclusion of all stakeholder into this work (especially students and teachers), the use of digital technologies to automate all types of information processing.

The analysis of scientific publications (see above) has shown that now the development of models of digital transformation is a topical, but underdeveloped issue. In the field of education, the research (Rof et al., 2020), devoted to this, analyzes in detail the impact of digital transformation on the business model of traditional universities. Another research (HolonIQ, 2020) describes an open-source capability framework for higher education (4 dimensions, 16 domains and more than 70 capabilities). The Navitas Ventures research (Nav, 2017) is dedicated to identifying leaders and facilitators of change in the digital transformation of higher education, as well as the groups most affected by the digital transformation. Such studies show the need to develop a concept of digital transformation of education in Ukraine and develop an appropriate model.

According to the developed generalized model of digital transformation (figure 2), the model of digital transformation of education contains similar components taking into account the specifics of the industry.

Figure 3 shows the generalized model of digital transformation of education that is developed by the authors.

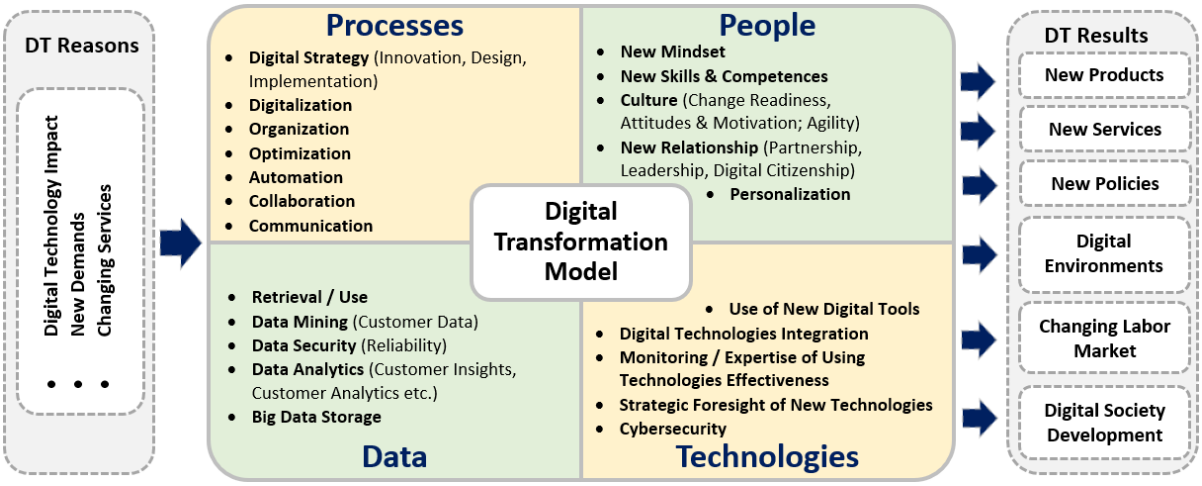

Figure 2: Digital Transformation Model (Morze and Strutynska, 2021).

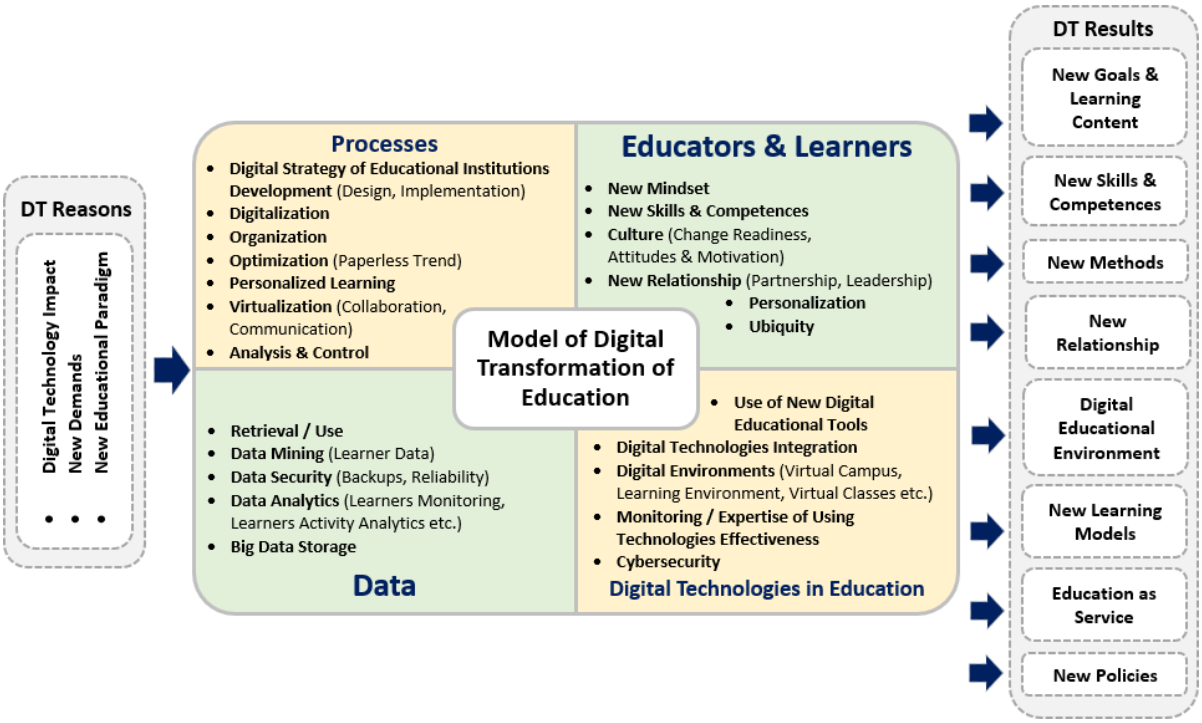

Figure 3: Model of Digital Transformation of Education

The proposed model takes into account the goals, features of the educational process and the conditions of using digital technologies to develop a modern educational ecosystem. The brief description is below.

Block **"Processes"**:

1. Digital Strategy of Educational Institutions Development (design, implementation).
2. Digitalization.
3. Organization.
4. Optimization (paperless trend).
5. Personalized Learning (Inquiry Based Learning, Project Based Learning).
6. Virtualization (virtual collaboration, virtual communication, virtual presence).
7. Analysis & Control.

Block **"People"** transforms into block **"Educators & Learners"**:

1. New Mindset (computational thinking, design mindset, emotional intelligence, social intelligence, etc.).

2. New Skills & Competences (digital skills & competences, soft skills, media literacy, transdisciplinary competences).
3. Culture (innovation culture, change readiness, attitudes & motivation for education; lifelong learning, non-formal learning, informal learning; agility).
4. New Relationship (partnership, leadership).
5. Personalization (personal learner profile, personal learning environment, personal educator profile, personal teaching environment, individual needs etc.).
6. Ubiquity.

Block **"Technologies"** transforms into block **"Digital Technologies in Education"**:

1. Use of New Digital Educational Tools (content management systems, learning content management systems, video conferencing tools, MOOCs, digital assessment tools, mobile learning tools & devices, Virtual Reality, Augmented Reality, Mixed Reality, 3D printing, robots in education, gamification, internet platforms for educational needs etc.)
2. Digital Technology Integration.
3. Digital Environments (virtual campus, learning environments, virtual spaces, virtual laboratories, virtual classes etc.).
4. Monitoring / Expertise of Using Technologies Effectiveness.
5. Cybersecurity.

Block **"Data"**:

1. Retrieval / Use.
2. Data Mining (learner data, data-driven decisions).
3. Data Security (backups, reliability).
4. Data Analytics (learners monitoring, learners activity analytics etc.)
5. Big Data Storage.

Thus, the areas of developing the digital transformation of education are following:

- transformation of goals, content and corresponding methods and forms of educational activities, which are associated with the penetration of new digital tools in various areas of human activity;
- educational institutions have to master new digital tools that increase the efficiency of the educational process;
- pupils/students should master new digital tools to increase the efficiency of their educational activities, and their digital competence needs developing;
- teachers should master:
  (a) new digital tools to increase the efficiency of their professional activities;
  (b) content, methods and forms of educational activities that are transformed due to the impact of new digital tools on various areas of human activity;
  (c) new digital tools that increase the efficiency of the educational process, which is also changing;
- education leaders should master:
  (a) new digital tools that increase the efficiency of their professional activities;
  (b) digital tools that increase the efficiency of the organization of the changing educational process.

Higher education systems and institutions are particularly affected by digital transformation, which can enable new services and provide new opportunities for innovation and entrepreneurship. Higher education institutions (HEIs) embracing digital technologies can become drivers of growth and development for their own ecosystems (OECD and European Union, 2019).

Impact of digital transformation and recent research states that avoiding DT is not an option, and that HEIs need to adapt to technological changes if they want to stay relevant (Wildan Zulfikar et al., 2018).

Implementing new technologies is inevitable, that HEIs must obligatorily implement new technologies to be digitally relevant, and that the real challenge is the right execution of available digital plans and strategies, engaging and empowering students, staff, and the faculty in the process (Nguyen, 2018).

However, now the main challenges for universities today are:

- involvement of students into studying with the use of modern methods,
- providing teachers with more opportunities to fulfil their potential,
- restructuring of the educational process,
- optimization of university management and internal processes.

The key point is the digital transformation, not the creation of digital analogues of paper or other physical media and processes. To achieve this, it is necessary to restructure all the processes in the university,

starting from the educational process and ending with the formation of new thinking of all its participants.

According to the models developed above (figures 2 and 3), we will consider the components that will change within the process of digital transformation of higher education institution (figure 4).

The main components of the proposed model include:

- educational environment (taking into account conditions of wide use of digital technologies there will be a virtualization of educational process, processes of communication, cooperation, and educational institution management);
- technology and tools used by teachers and students;
- conditions of teachers-students interaction within the digital environment; it is important to overcome the academic digital gap by developing professors' digital skills, as students are already highly motivated to use digital learning tools;
- management of university process and the internal process in general.

To determine the educators' awareness level in the field of digital transformation of education, as well as whether they are ready for these processes authors have conducted survey. The online survey was elaborated (in Ukrainian) using Google Forms. 134 Ukrainian educators have taken part in the present research (during December 2021). We guaranteed participants that only anonymized data would be shared. The survey contained information about processes of digital transformation of education. The gained data are presented in figures 5-9.

***Q.**: Which of the following in your opinion causes the digital transformation of education?*

Survey responses on the causes the digital transformation of education are shown in figure 5 (multiple answers are possible, that is why the total responses can be more than 100%):

As we can see from figure 5, the largest group of respondents defines of the digital technology impact (79%) and new requirements for the competence of specialists (62%) as the main causes the digital transformation of education. At the same time, about 48% of educators suggest that emergence of new professions also impact on the digital transformation of education.

If compare these results with our previous research in (Morze and Strutynska, 2021) we can make conclusion about increasing awareness level of the Ukrainian educators about processes of digital transformation of education.

***Q.**: What processes in your opinion need to be implemented for the digital transformation of education?*

Survey responses on processes need to be implemented for the digital transformation of education are shown in figure 6 (multiple answers are possible, that is why the total responses can be more than 100%).

Figure 6 are shown that the majority of respondents considered the most important steps for implementing the digital transformation of education are development of the digital educational environment (86%), development of the digital transformation strategy of an educational institution (83%) and digitalization of educational processes (66%).

At the same time, almost half of the respondents also understand the importance of taking other steps (introduction of paperless document management – 47%, introduction of paperless (electronic) document management – 36%, data analysis with the use of the digital technology – 36%). Thus, most educators correctly understand the processes that need to be implemented for the digital transformation of education.

***Q.**: Which of the following in your opinion can result from the digital transformation of education?*

Survey responses on respondents opinion about results from the digital transformation of education are shown in figure 7 (multiple answers are possible, that is why the total responses can be more than 100%):

As we can see from figure 7, the largest group of respondents defines digital educational environment as the main result from the digital transformation of education (81%). Other survey answers also show that educators correctly appreciate the results of the digital transformation of education in general, which corresponds to the models developed by the authors in figure 3 and figure 4.

***Q.**: What teachers need to do to implement an effective educational process under the conditions of the digital transformation in your opinion?*

Survey responses on respondents opinion about what teachers need to do to implement an effective educational process under the conditions of the digital transformation are shown in figure 8 (multiple answers are possible, that is why the total responses can be more than 100%).

Figure 8 are shown that the largest group of respondents believes that teachers need to master new digital tools (90%). At the same time, about 76% of educators suggest that teachers need to master new teaching aids. Thus, this means that educators understand that to implement the digital transformation of

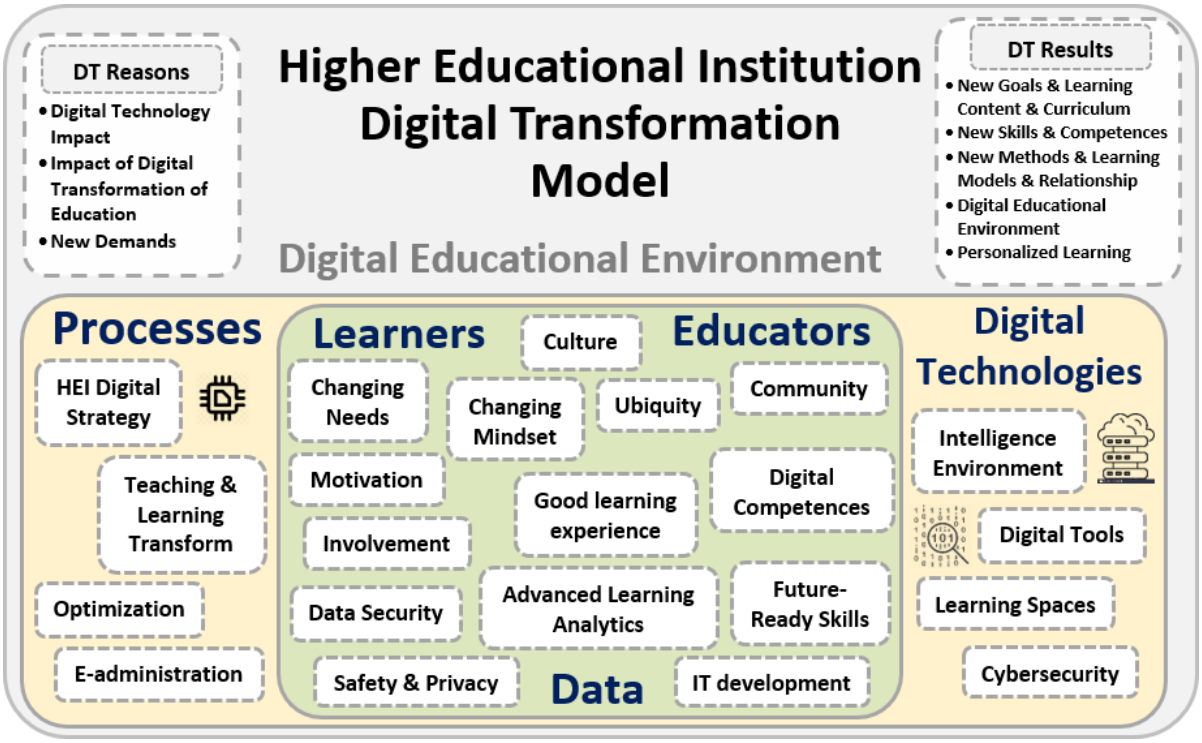

Figure 4: Higher Educational Institution Digital Transformation Model.

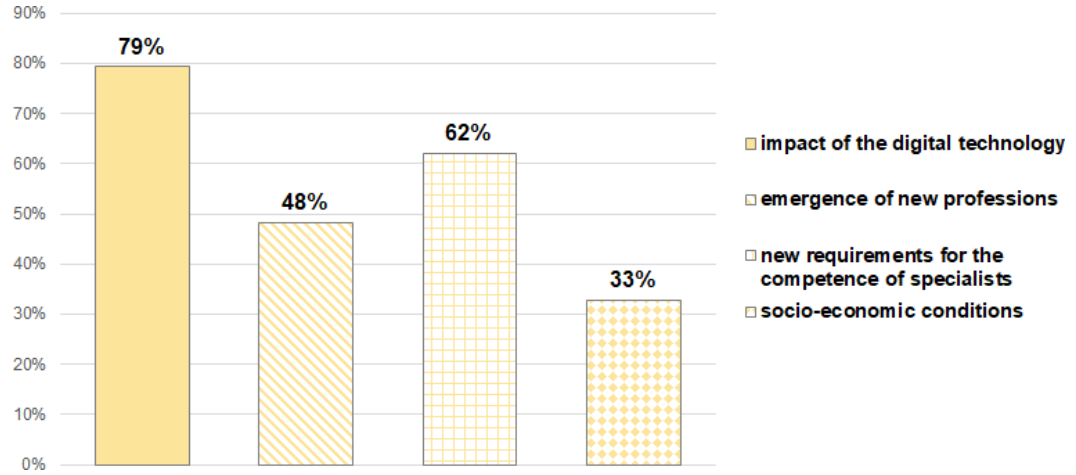

Figure 5: Survey responses on the causes the digital transformation of education.

education, first of all, it is necessary to increase digital competence.

***Q.**: What students need to do for studying under the conditions of the digital transformation in your opinion?*

Survey responses on respondents opinion about what what students need to do for studying under the conditions of the digital transformation are shown in figure 9 (multiple answers are possible, that is why the total responses can be more than 100%).

Figure 9 are shown the very similar results as answers in previous question (figure 8). That is the largest group of respondents believes that students need to master new digital tools (78%). Also 71% of educators suggest that students need to change own motivation for e-learning.

Thus, an envisioned model in response to the impact of digital transformation (figure 4) can be used as a roadmap for solutions for the digital transition to an innovative model for the functioning of the modern university.

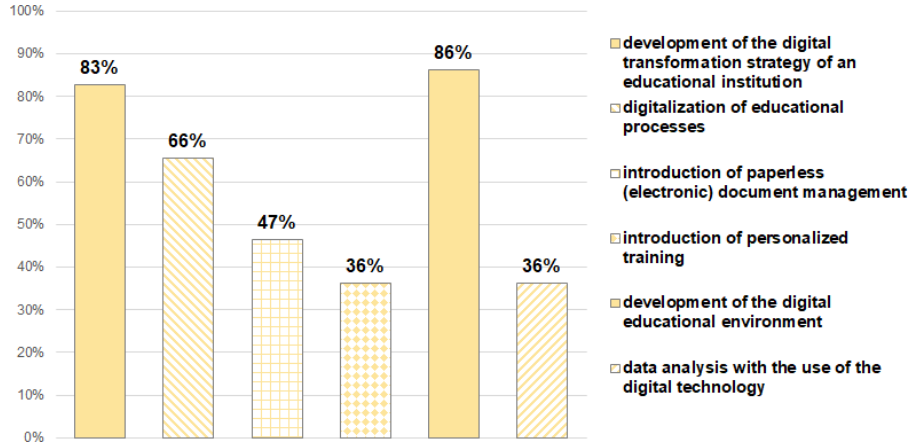

Figure 6: Survey responses on processes need to be implemented for the digital transformation of education.

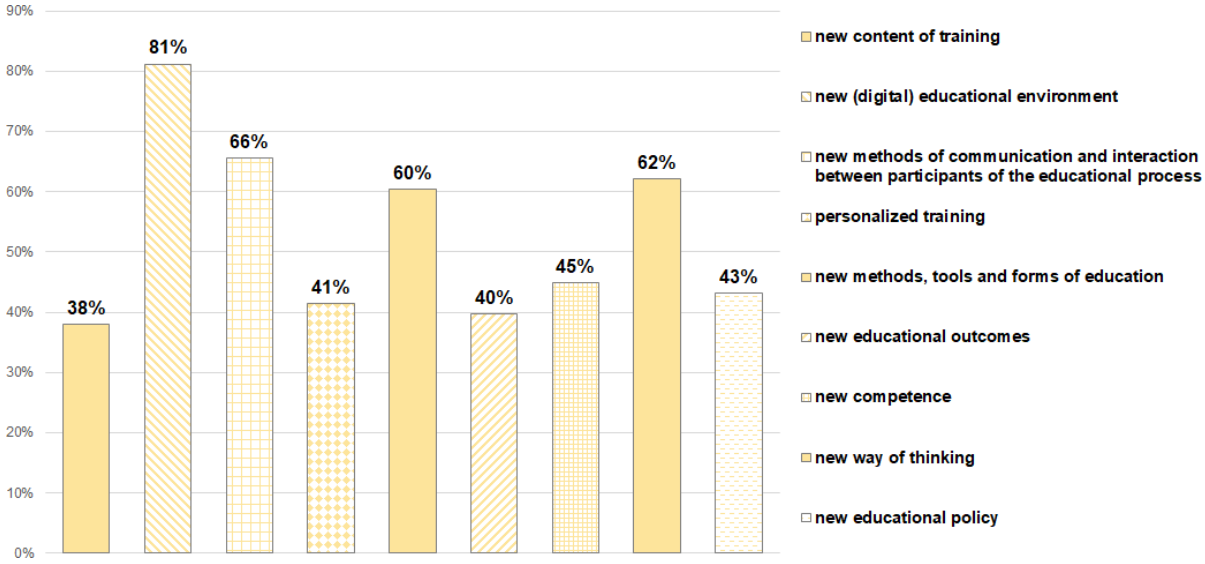

Figure 7: Survey responses on respondents opinion about results from the digital transformation of education.

5 CONCLUSIONS

Thus, the result of the digital transformation of education is:

- creating a modern digital educational environment to provide equal access to quality educational services and resources anywhere, anytime and in order to improve the quality of education;
- digitalization of all components of the educational process;
- effective use of modern digital technologies and data through the development of digital skills and competencies of all education stakeholders;
- formation of new competencies of the educational process participants, i.e., competencies which are necessary for a successful life in the digital society;
- defining requirements for digital competencies of heads of educational institutions and educational policy makers;
- developing special innovative courses for heads of educational institutions, which provided them with an understanding of the concept of digital transformation of education and ways to ensure its.

A number of important steps need to be taken at the state, regional and local levels to implement all the abovementioned in Ukraine. We define them taking into account the analysis and synthesis of similar experience and researches (Hrynevych et al., 2020; Strutynska, 2020; European Union, 2020; Sepúlveda, 2020; Morze et al., 2020).

State-level measures are:

- Creating a unified educational policy for the digi-

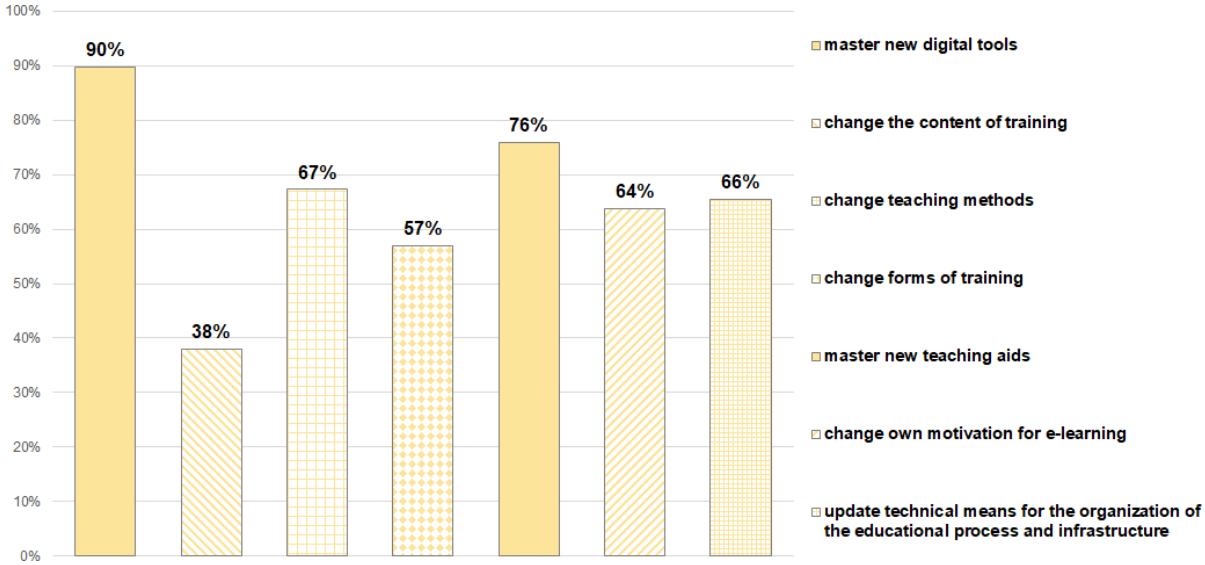

Figure 8: Survey responses on respondents opinion about what teachers need to do to implement an effective educational process under the conditions of the digital transformation.

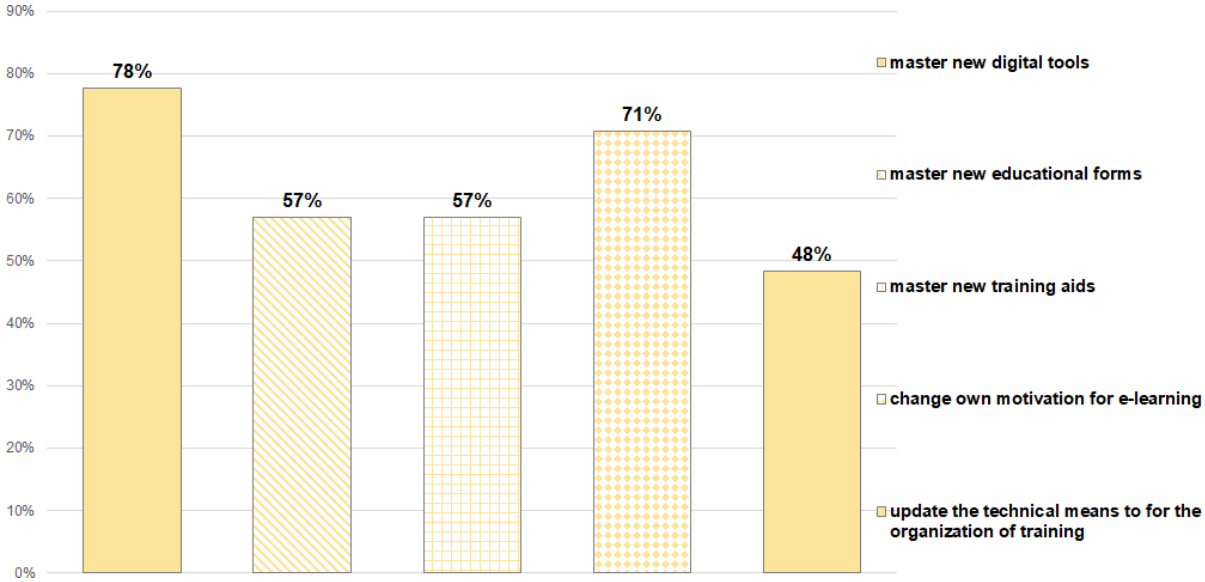

Figure 9: Survey responses on respondents opinion about what students need to do for studying under the conditions of the digital transformation.

tal transformation of education.

- Development of the necessary legal framework to ensure the digital transformation of education.
- Promoting the development of a highly efficient digital education ecosystem as a whole.
- Development and approval of the digital competence standard of the country citizen, including the teaching employee with the corresponding criteria of estimation of digital competence formation level.
- Strengthening cooperation and exchange of experience in models of digital education implementation with EU countries, support of interstate cooperation.

Regional-level measures are:

- Equipping educational institutions with modern computer equipment, as well as broadband connection of all educational institutions to the Internet, purchase of digital equipment, digital learning programs and platforms.
- Development of mechanisms for the implementa-

tion of the digital competence standard of teaching employees to improve the teachers' skills.

- Expanding the active use of distance and blended learning technologies through targeted training of heads of educational institutions and teachers.
- Updating the content of training of future teachers, especially on issues relating to use of digital technologies in the educational process, new approaches to educating of modern youth.
- Improving the digital skills and competencies of the population for digital transformation in general.

Institutional-level measures are:

- Increasing of access to distance learning technologies for teachers and students who have not had this access before (by providing access to the Internet and related equipment).
- Providing flexible curriculum taking into account models of full-time, distance and blended learning.
- Development of quality educational content based on the wide use of digital technologies and taking into account the principles of information security of all participants of the educational process while working with computer networks.
- Arranging of continuous training of educators.

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Formation Digital Intelligence of a Modern Economist: A Competence Approach

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Keywords: Digital Intelligence, Digital Security, Future Economist, Digital Economy, Digital Citizen, Digital Creator, Digital Entrepreneur.

Abstract: In the current context of the digitalization of various spheres of life, an important characteristic of participants in a digital society is the level of their digital intelligence. With the development of the digital economy, the skills of digital intelligence are required by all professionals in the field. The level of digital intelligence development of future economists during their university studies determines their successful employment and career development. The present paper analyzes the application of the competency approach to the formation of digital intelligence using the tools of the moodle platform. In the e-learning course, digital learning content was correlated with a competencies that are defined according to digital intelligence hoards. The authors demonstrate the stages of formation, indicators for different levels of formation, content and examples of educational representation of material. The results of the pilot study for achieving all three levels of digital intelligence are also presented. A statistical analysis of the results of the experiment was carried out and their relevance proved.

1 INTRODUCTION

The modern economy requires the digitization of economic processes, which is the basis of innovative development of economic systems. Digital economy is creating new products, shaping new needs, and the speed and volume of information is increasing day by day. The development of digital intelligence among economic actors offers significant opportunities to create and conduct business based on new technological solutions or business models not previously applied. At the current stage of the development of the global economy, digital tools were accompanying all aspects of economic activity, and digital data technology and e-business were receiving increasing attention.

The use of digital technologies is transforming the relations between the participants of economic activity in its various sectors. That is why the formation and development of digital competences in economists, both general and professional, is an important task for modern universities in preparing future economists and improving their skills. "The public interest in sustainable and continuous development of the quality of labor resources and the increase of their value finds concrete expression in the rule-making for modernization and achievement of effective structural changes in the education and qualification systems, herefore, the development of competency profiles and competency models in higher education is imperative. The realization of competence approach is meaningful, effective and supporting the future professional realization of the students and it should be prioritized. As a means of comparison with the rich theoretical experience and established practice, it is a real helper for the development of the higher education system as a responsibility not to the document, but to the result" (Nikolova Koleva, 2021). International and European institutions pay great attention to the development of standards of digital competence, in particular, the framework of digital intelligence provides the ability to adequately use digital technologies to work with data, management in-

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formation systems, economic risks, provide cybersecurity, digital communication and more. The development of such abilities among future economists needs to take place both during the training of information technology disciplines and in professionally oriented (vocational) academic disciplines. It is therefore necessary to develop the content, methods and forms for the formation and development of digital intelligence skills of future economists during university studies through appropriate educational programs.

The purpose of the present article is to define the notions, components, levels and characteristics of digital intelligence of the modern economist, to develop approaches to the formation and development of components of digital intelligence of future economists in higher education.

2 THE THEORETICAL BACKGROUND

Digital competences, computer skills, information literacy and related abilities represent a crucial element in ICT education (Information and Communication Technologies) (Stopar and Bartol, 2018). Digital competence is a basic skill for citizens and should be systematically assessed, taking into account characteristics such as knowledge, skills and attitudes (Hazar, 2018).

Digital skills are one of the most important conditions for the development of the digital market in any country, as they are directly or indirectly linked to all spheres of society and the economy. Significant work has been done by the European community to create the potential for digital transformation of education, in particular, to change the skills and competences requirements for citizens. The work was focused on developing a digital competency framework for citizens (DigComp), educators (DigCompEdu), educational organizations (DigCompOrg) and consumers (DigCompConsumers).

Digital competence is one of the key competences and is necessary for lifelong learning as it "involves the confident and critical use of electronic media for work, leisure and communication. It is related to logical and critical thinking, to skills for handling information at a high level". The DigComp conceptual reference model identifies 5 broad areas of digital competence, broken down into 21 competences (Park, 2019). The development of the entrepreneurial capacity of European citizens and organisations is one of the key policy objectives for the EU and Member States. European Commission identified sense of initiative and entrepreneurship as one of the 8 key competences necessary for a knowledge-based society. The EntreComp proposes a shared definition of entrepreneurship as a competence, with the aim to raise consensus among all stakeholders and to establish a bridge between the worlds of education and work (Bacigalupo et al., 2016). The European e-Competence Framework is not based on job profiles but rather on competences as this approach is more flexible. Its purpose is to provide general and comprehensive e-Competences specified at five proficiency levels that can then be adapted and customised into different contexts from ICT business and stakeholder application perspectives. The 41 competences of the framework are classified according to five main ICT business areas and relate to the European Qualifications Framework (Costa and Santos, 2017).

The level of digital competence of university students is determined in accordance with the DigCom 2.1 recommendations (González Calatayud et al., 2018; López-Meneses et al., 2020; Kuzminska et al., 2019), TPACK-21 (Schmidt et al., 2009; Valtonen et al., 2017; Miguel-Revilla et al., 2020).

Any framework of digital competence presented necessarily requires mastery of the components of digital intelligence. Park (Park, 2016) defines digital intelligence as a set of social, emotional and cognitive abilities that allow individuals to meet challenges and adapt to the requirements of digital life. By acknowledging conceptual dyad, digital intelligence could be a result of the process of digital learning (Kineshanko and Jugdev, 2017). Since digital technologies support the learning process and have become an educational subject as well as teaching content, the development of digital intelligence is encouraged in contemporary students (Škoda and Luić, 2019).

Today's education is best met by the concept of digital intelligence development that includes eight interconnected areas: digital identity, digital use, digital safety, digital security, digital emotional intelligence, digital communication, digital literacy, and digital rights (Dostál et al., 2017). Cismaru et al. (Cismaru et al., 2018) explores the development of four categories of skills (operational, informational, strategic and digital fluency) as dimensions of the digital intelligence.

Entrepreneurs are often pressed to create and launch products and services as quickly as possible to achieve a first-mover advantage in the market. In doing so, they tend to overlook cybersecurity threats and risks due to a lack of awareness and insufficient funding. This can lead to theft of intellectual property, project failure, and inaccurate risk assessment (Plachkinova and Pittz, 2021).

3 IMPLEMENTATION

Digital economy is based on information and communication and digital technologies, the rapid development and spread of which are already affecting the traditional (physical-analogue) economy, transforming it from a resource-consuming economy to a resource-creating economy. Data are the key resource of the digital economy, generated and enabled by electronic communications through the operation of digital devices, tools and systems. In order to achieve digital competitiveness in the digital economy, it is necessary to develop the digital intelligence skills in a future economist.

Similar to IQ and EQ, which are used to measure general and emotional intelligence, digital skills are DQ (Digital Quotient), which is digital intelligence. The DQ framework contains 3 levels of digital intelligence (Deepak, 2017):

- "digital citizenship" is the use of digital technologies in everyday life, for interaction with each other, communication, viewing of digital content, etc.;
- "digital creativity" is the use of digital technologies to create content, media, applications, etc.;
- "digital entrepreneurship" is the use of digital technologies for business, professional activity, etc.

The defined levels are applied to such components of digital intelligence as: Digital Changemaker Identity, Digital Use, Digital Safety, Digital Security, Digital Emotional Intelligence, Digital Communication, Digital Literacy, Digital Rights. In order to determine indicators for all components of the future economist's digital intelligence, it is necessary not only to analyze the DQ framework, but also the labor market requirements to the competences of a modern digital economist. The description of the components of digital intelligence is presented in figure 1. Thus, two basic academic disciplines – "Information Technology in Economics" and "Database Management Systems", in the program of training of specialists in the economy are responsible for the formation of digital skills.

According to the data of DQ Institute, a person possesses **Digital Changemaker Identity** if he/she knows the general and emerging trends in the digital environment, identifies and evaluates innovative opportunities for business or social impact, provided by the improvement of new technologies, development of higher-order thinking skills, expansion of thinking beyond the individual scale to integrate digital networks and tools in response to broader social and economic challenges. Such people demonstrate professionalism and value, an interest in understanding the existing gaps in their digital competence and technology, using them for self-development and further business growth (Park, 2019). At The Future of Jobs Report forum, it was stated that the more work on soft skills in addition to hard skills, the more navigate easily tomorrow's job market (The Future of Jobs Report, 2020). Soft skills are crucial for the complex and dynamic process of career management and development for an economist mostly within the knowledge-based society context (Suciu and Lacatus, 2014). Teaching detailed and nuanced industry knowledge is arguably beyond the scope of entrepreneurship education systems, but to an extent, it is of paramount importance that students are exposed to the organic industry knowledge through interaction and experiential experiences. Within such interaction, the development of convergent 21st century skills such as social elationships, leadership, creativity and critical thinking further nurture entrepreneurial intents among students (Ghafar, 2020). The indicator of the **Digital Changemaker Identity** is the ability to identify and develop yourself as a competent digital technology user in Economics. To reach the Digital Citizen level, it is enough for a modern economist to understand the possibilities of using digital technologies to build your own image and the impact of knowledge and technology on professional development; use technologies to control and form your own digital identity; to demonstrate honesty in technology use and self-efficacy by finding ways to take advantage of the opportunities available to you in the digital environment. The level of "Digital Creator" presupposes the future economist's understanding of how to be aware of the progress of ICT, as well as the ability to integrate digital technologies in professional life; having a healthy identity as the co-creator of the digital ecosystem, able to explore and identify contemporary problems, jointly develop new ideas for their solution through technology. To reach the Digital Entrepreneur level, it is necessary to be able to identify and evaluate innovative business or social impact opportunities that are enhanced by new technologies; monitor and integrate emerging trends and technologies, structure data collection to identify new technology products / services that determine the potential added value of the business for sustainability and profitability of the business. Within the framework of both academic disciplines, namely "Information Systems and Technology in Economics" and "Database Management Systems" the **Digital Changemaker Identity** skills can be developed through the use of project-based, case-based, and practice-oriented training.

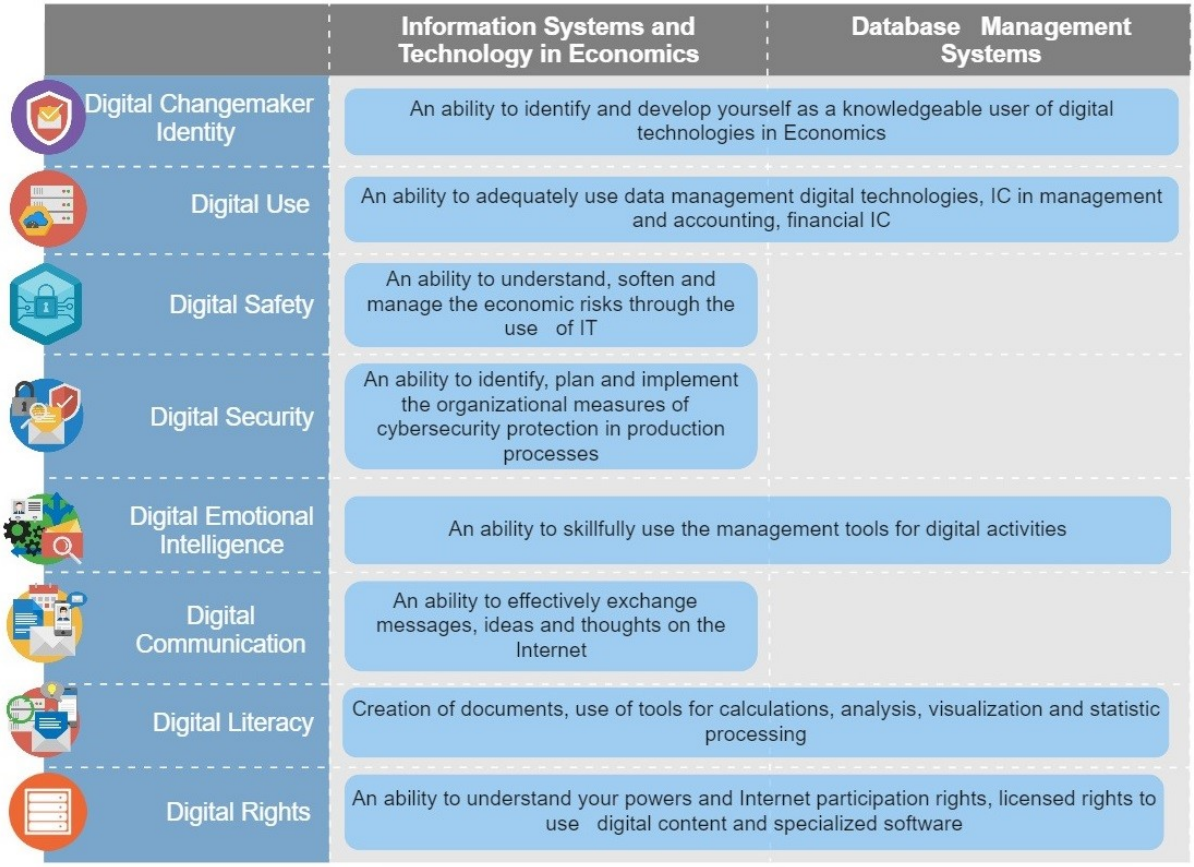

Figure 1: Components of digital intelligence.

Digital data technology, information systems in management, accounting and finance are increasingly playing a key role in managing business processes, including all areas of economic activity, and future economists therefore need **Digital Use** skills. In (Wong et al., 2016) several considerations and suggestions are drawn in terms of rethinking and pursuing usability in training when applied to Enterprise Resource Planning (ERP), and other business process management software systems, SAP, which comes as an integrated solution that incorporates the key business functions and processes of an organization. The rapid growth through the use of Enterprise Resource Planning (ERP) systems by Indonesian companies has been responded by ERP vendors in providing skilled human resources in ERP environment by cooperating with universities, particularly for training accounting students. Satisfaction with class and instructor influence perceived ease of use, students feel satisfied with ERP training and this affects their intentions in using ERP in the future (Imbiri, 2019). Chen and Zhou (Chen and Zhou, 2013) presents the enterprise resource planning (ERP) course layout aiming at the current problems from six aspects of the curriculum, teaching content, teaching resource, teaching method, teaching evaluation, teacher training. Shraideh et al. (Shraideh et al., 2018) conducted a practical course for teaching topics of SAP Leonardo and SAP HANA by suggesting model for conducting a capstone course consisting of eight phases. The model is geared to teaching new and innovative industry-related topics by using a project-based learning approach including elements of experiential learning and role-play teaching. The **Digital Citizen** level assumes the modern economist's understanding of the impact of the use of digital technologies on health, productivity of work, welfare and lifestyle, the possession of the relevant knowledge to solve these consequences; the use of technology in a targeted manner to achieve better objectives, effective use of digital content and tools for their own benefit. At the same time, a modern economist with a **Digital creativity** level has to be able to develop new ideas for solving the given tasks; to use self-motivation and ingenuity in using technologies in professional activity, for allocating avail-

able resources; to select and use digital technologies and information systems to plan and execute business processes. To attain the **Digital entrepreneur** level a student must use digital technologies to improve organizations, achieve business goals, work with economic indicators, information systems covering all spheres of economic activity, use systems to manage enterprise resources; to create, implement and use information systems and technology in different spheres of economic activity. The formation and development of such skills is ensured in the course of studying "Information Systems and Technology in Economics" and "Database management systems" academic disciplines, as well as professionally oriented disciplines in economics, accounting, analysis, modeling, management.

Organizations are faced with increasing complexity, uncertainty and enhanced threats from a wide range of forces. Depending on how this situation is handled, it can become risk or opportunity to erode or enhance business value. In addition, organizations have to meet most different stakeholders', legal and regulatory risk management requirements, comprehensive enterprise risk management are challenge and core competence for organizations' sustainable success (Stoll, 2015). Raanan (Raanan, 2009) research which applications of risk management to many aspects of modern life, from insurance, banking, health issues, business ventures, to project management and more. The **Digital Safety** indicator is the ability to understand, mitigate and manage economic risks using IT. To reach the level of a Digital Citizen the future economist needs: to understand the different types of behavioral cyber risks, how he/she can face these risks, how these risks can affect him/her; to develop the necessary technical, socio-cognitive, communicative and decision-making skills to deal with cyber risk situations when they occur, and know the tools to overcome these negative outcomes on the Internet. The Digital Creator level involves understanding the cyber risks of content they face on the Internet and the strategies associated with appropriate behavior, and the skills needed to develop and use conflict management techniques to reduce these risks. In order to reach the level of Digital Entrepreneur it is necessary to understand different types of cyber risks of commercial organizations, which can cause cessation or slowdown of business processes, loss of competitive advantage, loss of customers or profit, reduction of the business value and so forth. In addition, in order to encourage the use of digital entrepreneurship, it is necessary to be able to identify such risks and to develop creative strategies using digital tools to address and prevent the threats associated with those risks.

Integration of digital security skills as an independent variable is critical to the understanding of the use of online protective measures. Having the necessary skills and knowledge to engage in a cyber-safety behavior can help users avoid cyber-victimization, reducing the odds of negative outcomes such as the theft of data, money or personal information (Dodel and Mesch, 2018). Knowledge and skills in the areas of information security, information privacy, and copyright/intellectual property rights and protection are of key importance for organizational and individual success in an evolving society and labour market in which information is a core resource (Burkell et al., 2015). The indicators Digital Security are the ability to recognize, plan and deploy organizational cybersecurity tools in manufacturing processes. At the same time, it is sufficient for an economist possessing the Digital Citizen level to recognize and eliminate technical and software cyber threats at the level of the operating system, work in the network, work with personal data and copyrighted content, to know the types of threats in the digital environment, identify strategies and tools to be used to avoid such threats, use digital technologies without compromising their data and devices. The Digital Creativity level implies the ability to plan and implement cybersecurity protection in the creation of digital content, organization of data security and working information systems, identify vulnerabilities, quantify associated risks (e.g., income deficiency or business losses), use tools, strategies and protocols to ensure and improve data privacy and security. To reach the Digital Entrepreneur level, one needs to be able to organize a secure information environment for the business organization, to actively support cyber security in the organization, providing advice and guidance on potential risks and strategies for addressing them by developing and adhering to already developed communication strategies for organizations to ensure adoption and compliance of security policies and standards that ensure a viable environment for the enterprise. The formation of students' Digital Security level is carried out in the process of mastering the content-rich Module "Digital Security: Protection in the Digital Environment" within the framework of Information Systems and Technology in Economics course.

It is widely acknowledged that emotional intelligence is a crucial component in organizations. It has been proved that leaders and employees who are emotionally intelligent are more efficient, creative, and make better decisions (Bonesso et al., 2020). In today's digital and technical environment, employers are looking for personnel that can contribute to the organization not only with the use of technical skills but

can also express their expertise with the use of positive emotional intelligence and communication effectiveness (Hendon et al., 2017). The indicator of Digital Emotional Intelligence is the possibility to skillfully use digital tools for management. To master the Digital Citizen level the future economists should possess social and emotional skills in digital interaction of people, connected with both psychological interaction and practical, physical actions in confirmation of socially determined socially significant things. In order to reach the level of Digital Creator it is necessary to identify, understand and use your own emotional states, to be able to direct them, promote cooperation and positive interaction between internal and external interested parties in order to achieve the set goal; to understand and use your own emotional states, which are derivative and primary to digital media and personal value systems. The Digital Entrepreneur level implies the ability to develop interpersonal skills, the ability to manage one's emotions, understand emotional responses and behaviors depending on the context and digital environment, the ability to build partnerships at personal, local, social and global levels to achieve organizational goals. The formation and development of such skills are ensured in the process of studying basic academic disciplines in information technologies – namely, Database Management Systems and Information Systems and Technology in Economics, as well as professionally oriented academic disciplines in management, project management and business modeling.

The importance of **Digital Communication** for economists is beyond question, as information and communication technologies are a driver of the digital economy (Domazet and Lazić, 2017). Digital communication and collaboration use features of digital technologies with confidence for communication, cooperation and collaboration; effectively search, find, retrieve, process and communicate information from a variety of digital sources and in a variety of formats (Gekara et al., 2019). The ability for an undergraduate economist to apply analytical skills to economic issues of contemporary relevance is an integral part of their tertiary training. In order to encourage students O'Brien and Freund (O'Brien and Freund, 2018) explored the potential for future economists to exploit their social media communication skills with reflective blogging. The indicator of Digital Communication is an ability to effectively exchange messages, ideas and thoughts on the Internet. Herein, it is enough for an economist with the Digital Citizen level to know and to be able to use various communication tools for effective messaging. The level of Digital Creativity implies the ability to create and transmit digital content, independently organize communication channels for communications (for a large number of users inclusive); to store message histories, to resume task on the needed Internet page, the ability to use multiple communication tools without disrupting the workflow; as well as the ability to create and organize videoconferencing; etc. Digital Communication for an economist on the third level implies the ability to create and establish different communication environments to discuss and formulate business strategies and tactics in order to achieve the organization's goals. This level partly overlaps with Entrepreneurial competence and is one of the main components of Digital Competence. The formation of appropriate skills of Digital Communication in future economists can be carried out within Information Systems and Technology in Economics academic discipline while studying the informative module "Digital Communications in Global Space". Therefore, Digital Communication for the modern economist is both the ability to use the tools of gathering and disseminating professional economic information and data, assessible through digital means.

Information technologies are rapidly evolving and changing, along with that the term Digital Literacy is constantly acquiring new interpretations. This means that the role of information technologies in training specialists in different areas is undergoing constant change as well (Pangrazio, 2014; Santos and Serpa, 2017; Spante et al., 2018). As stressed by Murray and Pérez (Murray and Pérez, 2014), many students entering the university today have a high level of exposure to digital technologies and media. However, they are not prepared to cross the bridge between personal and academic use of technology. As academic knowhow is gained through formal education, so too must technological prowess be gained through structured learning experiences. Chan et al. (Chan et al., 2017) define digital literacy as "the ability to understand and use information in multiple formats with emphasis on critical thinking". The indicator of Digital Literacy of a future economist the creation of documents, use of tools for calculations, analysis, visualization and statistic processing. The Digital Citizen level implies the ability to find, process, organize, visualize and store economic data. To reach the Digital Creator level, it is necessary to be able to work with software environments for automation of processes of economic data processing (statistical, analytical); to create and use database management systems, data warehouses; to create and use economic and mathematical methods and models, diagnostic methods of control and estimation of the level of economic growth by means of automation using digital

tools; to model and forecast economic processes using modern digital technologies. At the highest level of Digital Literacy the Digital Entrepreneur implies the ability of a student to design databases, information systems, algorithms and data collection tools, to develop decision-making models. Economists may achieve such a level of Digital Literacy if they possess experience of using different technologies gained not only within the framework of studying such academic disciplines as Information Systems and Technology in Economics and Database Management Systems at the university, but also in the process of professional activity.

Organizations require skilled and knowledgeable professionals who understand risks and responsibilities related to the management of information privacy, information security, and copyright/intellectual property (Burkell et al., 2015). New digital networked technologies enable users to participate in the consumption, distribution, and creation of content in ways that are revolutionary for both culture and industry. Young people operate in the digital realm overwhelmingly ignorant of the rights, and to a lesser degree the restrictions, established in copyright law (Palfrey et al., 2009). Software publishers use digital rights management, specifically copy-protection techniques, to prevent unauthorized and illegal copying of their software products (Djekic and Loebbecke, 2005). The indicators of Digital Rights are the ability to understand your powers and Internet participation rights, licensed rights to use digital content and specialized software. Thus, to reach the level of a Digital Citizen, it is sufficient to understand the concept of confidentiality as a human right, what personal information is and how it can be used, stored, processed and shared on digital platforms along with strategies and tools that help keep personal information private and secure, is aware of copyright licenses and Creative Commons tools, licensing choices for licensors. The Digital Creator level implies the knowledge of the law and rights regarding the ownership of information and content hosted in a digital environment, the ability to distinguish between creative use and appropriation of someone else's work; the ability to track and manage changes to your digital content to protect your/organizational assets from unauthorized changes or unauthorized use; to design and use patents, trademarks, copyrights to protect your digital works through a variety of tools and applicable legislation. In order to reach the level of a Digital Entrepreneur, it is necessary to effectively integrate legislation with one's own practice to ensure the support and enforcement of digital rights in the digital environment as part of the entrepreneurial activity.

Competency indicators have been developed for each component of digital intelligence.

Indicators of digital intelligence skills at the level of "Digital Citizen":

- **DI1. Digital Changemaker Identity** (using digital technologies to build your own image and the impact of knowledge and technology on professional development; using technologies to control and form your own digital identity; demonstrating honesty in technology use and self-efficacy by finding ways to take advantage of the opportunities available to you in the digital environment);
- **DI2. Digital Use** (understanding of the impact of the use of digital technologies on health, productivity of work, welfare and lifestyle, the possession of the relevant knowledge to solve these consequences; the use of technology in a targeted manner to achieve better objectives, effective use of digital content and tools for their own benefit);
- **DI3. Digital Safety** (understand the different types of behavioural cyber risks, how he/she can face these risks, how these risks can affect him/her; develop the necessary technical, socio-cognitive, communicative and decision-making skills to deal with cyber risk situations when they occur; know the tools to overcome these negative outcomes on the Internet);
- **DI4. Digital Security** (ability to recognizing and eliminate technical and software cyber threats at the level of the operating system; work in the network, with personal data and copyrighted content; know the types of threats in the digital environment, identify strategies and tools to be used to avoid such threats; use digital technologies without compromising their data and devices);
- **DI5. Digital Emotional Intelligence** (possess social and emotional skills in digital interaction of people, connected with both psychological interaction and practical, physical actions in confirmation of socially determined socially significant things);
- **DI6. Digital Communication** (level to know and to be able to use various communication tools for effective messaging);
- **DI7. Digital Literacy** (ability to find, process, organize, visualize and store economic data);
- **DI8. Digital Rights** (understand the concept of confidentiality as a human right, what personal information is and how it can be used, stored, processed and shared on digital platforms along with strategies and tools that help keep personal information private and secure; is aware of copyright

licenses and Creative Commons tools, licensing choices for licensors).

Indicators of digital intelligence skills at the level of "Digital Creator":

- **DI1. Digital Changemaker Identity** (future economist's understanding of how to be aware of the progress of ICT; ability to integrate digital technologies in professional life; ability to explore and identify contemporary problems, jointly develop new ideas for their solution through technology);
- **DI2. Digital Use** (ability to develop new ideas for solving the given tasks; to use self-motivation and ingenuity in using technologies in professional activity, for allocating available resources; select and use digital technologies and information systems to plan and execute business processes);
- **DI3. Digital Safety** (understanding the cyber risks of content they face on the Internet; understanding the strategies associated with appropriate behavior, and the skills needed to develop; using conflict management techniques to reduce cyber risks);
- **DI4. Digital Security** (ability to plan and implement cybersecurity protection in the creation of digital content, organization of data security and working information systems; identify vulnerabilities, quantify associated risks (e.g., income deficiency or business losses); use tools, strategies and protocols to ensure and improve data privacy and security);
- **DI5. Digital Emotional Intelligence** (identify, understand and use your own emotional states, to be able to direct them; promote cooperation and positive interaction between internal and external interested parties in order to achieve the set goal; understand and use your own emotional states, which are derivative and primary to digital media and personal value systems);
- **DI6. Digital Communication** (create and transmit digital content, independently organize communication channels for communications (for a large number of users inclusive); store message histories, to resume task on the needed Internet page, the ability to use multiple communication tools without disrupting the workflow; ability to creating and organize videoconferencing);
- **DI7. Digital Literacy** (ability to work with software environments for automation of processes of economic data processing (statistical, analytical); ability to create and use database management systems, data warehouses; ability to create and use economic and mathematical methods and models, diagnostic methods of control and estimation of the level of economic growth by means of automation using digital tools; ability to model and forecast economic processes using modern digital technologies);
- **DI8. Digital Rights** (knowledge of the law and rights regarding the ownership of information and content hosted in a digital environment; ability to distinguish between creative use and appropriation of someone else's work; ability to track and manage changes to your digital content to protect your/organizational assets from unauthorized changes or unauthorized use; ability to design and use patents, trademarks, copyrights to protect your digital works through a variety of tools and applicable legislation).

Indicators of digital intelligence skills at the level of "Digital Entrepreneur":

- **DI1. Digital Changemaker Identity** (ability to identify and evaluate innovative business or social impact opportunities that are enhanced by new technologies; ability to monitor and integrate emerging trends and technologies; ability to structure data collection to identify new technology products / services that determine the potential added value of the business for sustainability and profitability of the business);
- **DI2. Digital Use** (use digital technologies to improve organizations, achieve business goals, work with economic indicators, information systems covering all spheres of economic activity, use systems to manage enterprise resources; create, implement and use information systems and technology in different spheres of economic activity);
- **DI3. Digital Safety** (understand different types of cyber risks of commercial organizations, which can cause cessation or slowdown of business processes, loss of competitive advantage, loss of customers or profit, reduction of the business value and so forth; ability to identify risks and to develop creative strategies using digital tools to address and prevent the threats associated with those risks);
- **DI4. Digital Security** (ability to organize a secure information environment for the business organization; ability to support cyber security in the organization, providing advice and guidance on potential risks and strategies for addressing them by developing and adhering to already developed communication strategies for organizations to ensure adoption and compliance of security policies

and standards that ensure a viable environment for the enterprise);

- **DI5. Digital Emotional Intelligence** (ability to develop interpersonal skills; ability to manage one's emotions, understand emotional responses and behaviors depending on the context and digital environment; ability to build partnerships at personal, local, social and global levels to achieve organizational goals);
- **DI6. Digital Communication** (ability to create and establish different communication environments to discuss; ability to formulate business strategies and tactics in order to achieve the organization's goals);
- **DI7. Digital Literacy** (ability of a student to design databases, information systems, algorithms and data collection tools; develop decision-making models);
- **DI8.Digital Rights** (ability to effectively integrate legislation with one's own practice to ensure the support and enforcement of digital rights in the digital environment as part of the entrepreneurial activity).

4 THE RESULTS OF EXPERIMENTAL WORK

The pedagogical experiment on the development of digital intelligence competences for future economists lasted for 3 years and involved the first year students majoring in Economic (the total of 142 students). The formation and development of digital intelligence skills of future economists was carried out within the framework of studying the Information Systems and Technology in Economics academic discipline. The formation of DQ was carried out in 3 stages: (1) Digital Citizenship through two content modules in the Information Systems and Technology course; (2) Digital Creativity through a competency-based project; (3) Digital Entrepreneurship through practical training using real-life work situations. The course of experimental research included measuring students' digital intelligence skills before the start of the discipline and at the end of each stage.

The course content modules on Information Systems and Technology in Economics included: Digital Identity and Rights of the Modern Economist, Digital Security: Protection in the Digital Environment, Cyber Risks in the Public Digital Domain, Digital Communications in the Information Environment, Economic Data Tools, Visualisation of Economic Information, Digital Tools for Economist Management, Information Systems for Economic Activity. The process of forming appropriate skills in accordance with the components of digital intelligence level "Digital Citizen" was provided by a set of educational resources and services, tasks for laboratory work.

The e-learning course (ETC), based on the Moodle platform, was used as an internal resource for the university's e-learning environment to learn theoretical educational material to organize the educational process of future economists.

To determine the acquisition by students of the necessary competencies by the means available in the moodle system, the following was created:

- Technical representation of the competency framework within the system competencies repository.
- Assignment of relevant competencies to the training course.
- Assignment of appropriate competencies to individual elements of the e-learning course.

The digital competence framework includes (figure 2):

- indicator
  - level
    - exponent

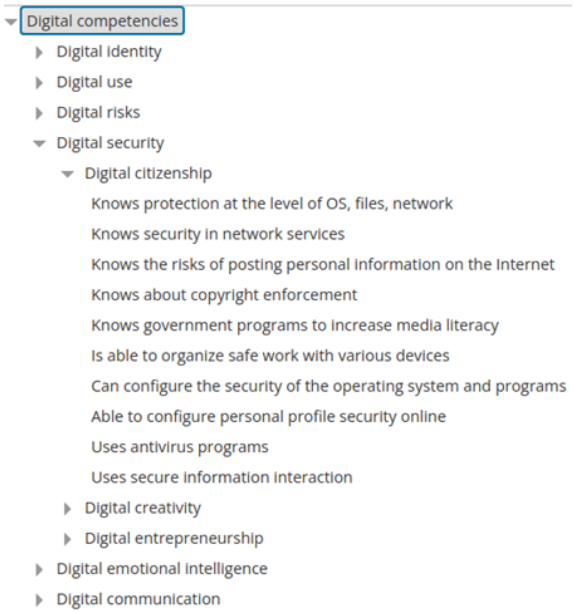

Figure 2: Digital competence framework in the Moodle system.

The content of the competency framework corresponds to the components of digital intelligence skills with have been added to the relevant e-learning course.

But simply the technical definition of the course in which the relevant competencies will be formed is not enough to recognize that the student has acquired these competencies. A prerequisite is the presence of educational elements, the successful development of which will symbolize that the student has acquired the competencies that these elements are designed to develop in him.

At the same time, different approaches to determine the acquisition of competencies were identified for different indicators.

To obtain the competencies "knows…" the student must review the theoretical material (read the text, watch the study video, presentation, etc.) and successfully pass the training test. The Moodle system allows you to track the successful completion of educational elements by students both automatically (fulfillment of requirements) and by students themselves (personal determination of the state of understanding of the material received). Therefore, the student can independently determine the theoretical material as performed, and the test is marked as completed when receiving a grade above 60% of the maximum. Only when all these conditions are met is the indicator of competence considered achieved.

To obtain competencies "able…" students were asked to perform a set of tasks in laboratory work. The conditions for determining these tasks as performed (and, consequently, obtaining the relevant indicators of competence, which are tied to these tasks) are to provide for the verification of work performed and receive an assessment of at least 60% of the maximum (figure 3).

When using the option of students gaining knowledge through non-formal education, to confirm the acquired competence, it was proposed to provide evidence of successful completion of third-party courses by uploading a certificate in the e-learning course. After verification of the certificate, the teacher confirmed the acquisition of competence.

Determining the achievement of competency indicators "uses…" can no longer be done automatically. In this case, the educational elements of the e-course require the student to request confirmation of the acquisition of appropriate competence from the teacher. According to the results of research conducted by the student, completed project task or completed practice, the teacher marks the acquisition of competence.

Thus, we obtained a list of activities aimed at forming the appropriate capabilities for each component of digital intelligence of the future economist (figure 4)

Also, control tasks and tests were formed according to certain indicators. Each student gained access

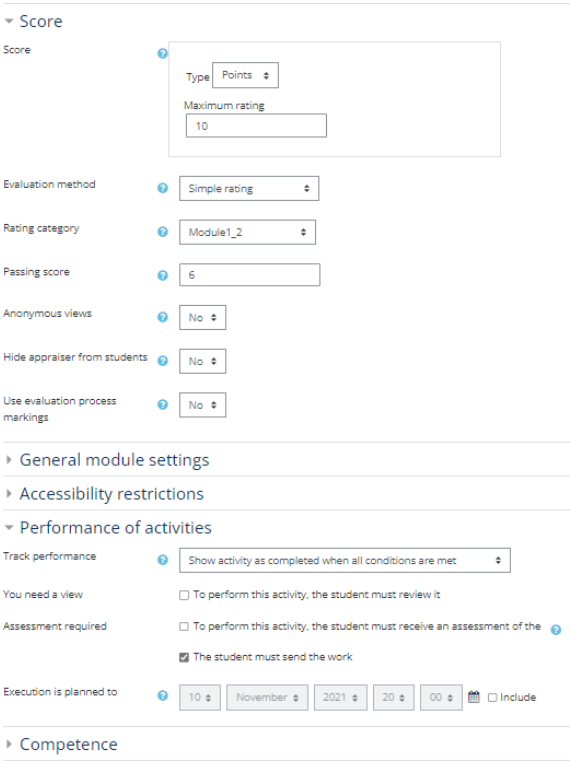

Figure 3: Adjustment of the passing score and conditions of the performance.

to the structure of digital competence and the corresponding activities that must be performed for the successful formation of digital competence. The figure 5 shows a screen with the activities that the student sees. After completing tasks for laboratory and independent work, the student undergoes control activities, the results of which determine the level of formation of digital competence (for each component). The results of the formed components of digital competence the student can see after his teacher evaluates the relevant activities in the e-learning course or after presenting a certificate of mastery of the relevant mass online courses, which certifies the formation of relevant competencies.

After completing the two modules of the discipline, students were offered a project assignment to achieve the Digital Creativity level. During the project work, students learned how to apply a set of services and tools developed during theoretical training to solve different types of tasks related to economic activity of an enterprise. Before starting the tasks of this project, the students had to split into small groups, plan the teamwork, choose a service to manage the project, assign roles to the participants, set areas of responsibility and deadlines for the tasks. In the course of the project assignment, the students were asked to develop the information structure of

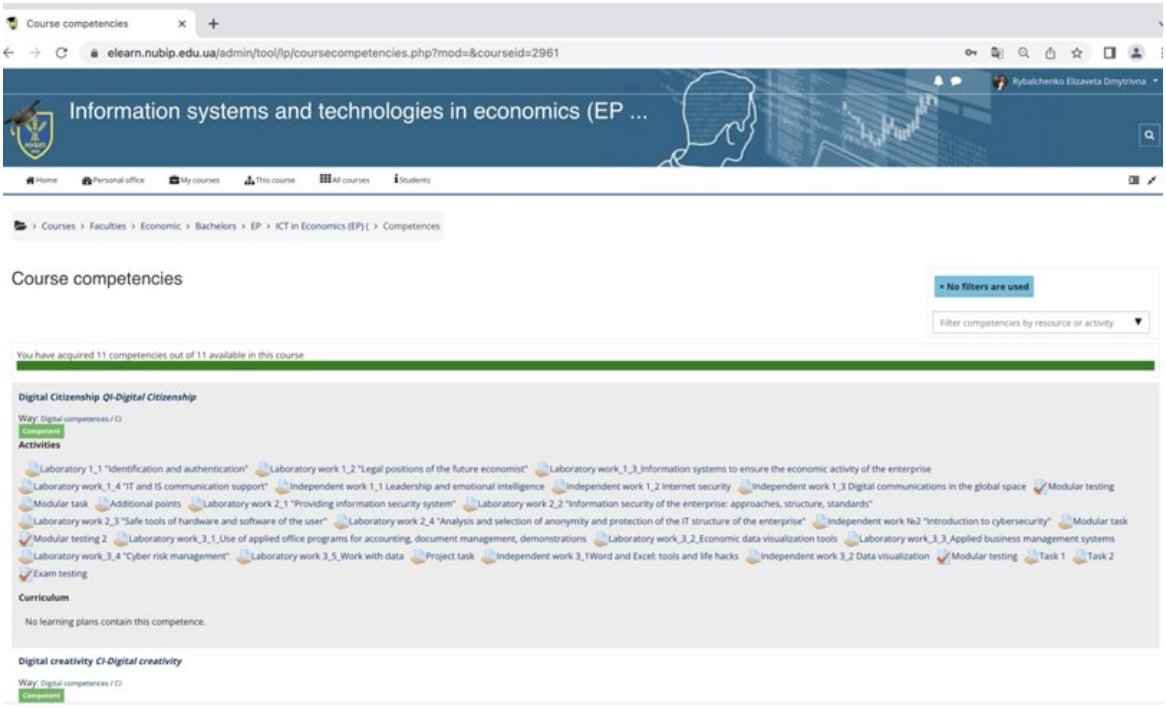

Figure 4: Correspondence of competencies and activities within one of the components of digital competence.

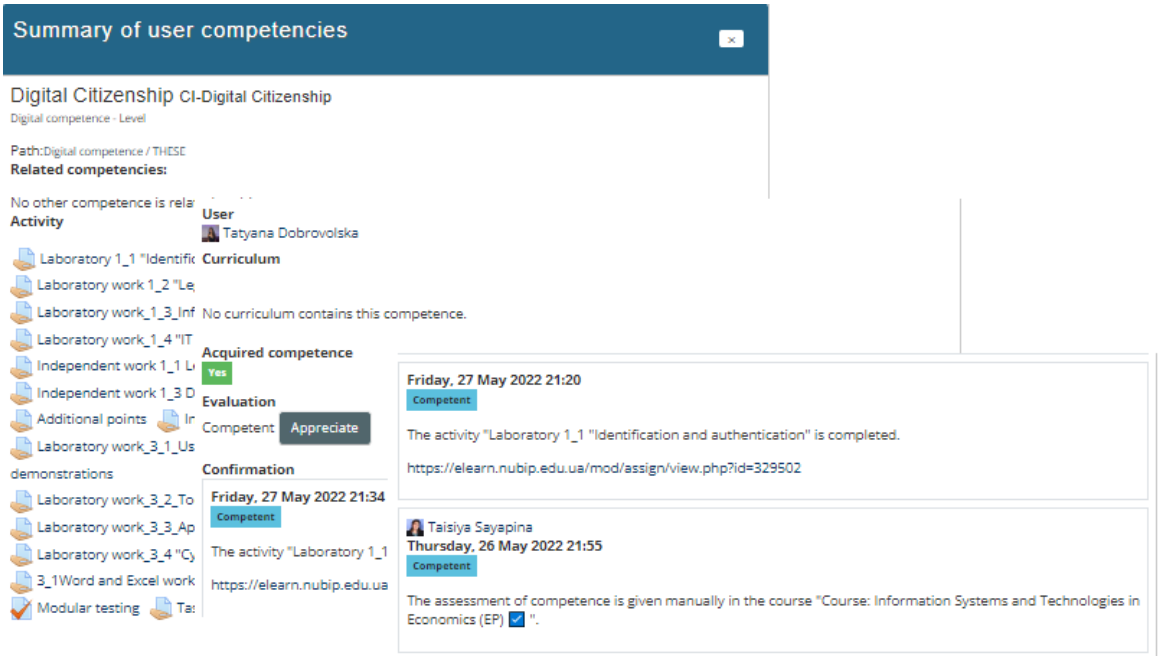

Figure 5: The final page of the student's competence.

the virtual business activity based on the analysed organisational and functional structure of the enterprise; to select the software for economic activity (processing, systematisation, visualisation and storage of economic data), tools for confidentiality and data security using appropriate cloud services.

In order to achieve the "Digital Entrepreneurship" level of the learning experience, the students were asked to solve a case study based on the production situation described. An example of such a task is given below. "A retail chain is planning to expand its branches. Given the number of employees, customers

and counterparties of the company planned after the expansion, to analyse the technical and functional characteristics of the existing systems in the market and to select the optimal in terms of purchase and maintenance costs: CRM-system; tool for checking the activities of counterparties; tool for assessing the financial performance of the company. Evaluate the cost of implementing such systems in the company. Set up user authorisation rules in the selected systems to ensure the security of company data". The result of the completed task is a presentation of the completed work in the form of a joint document, which is generated by all participants of the project.

As a result, after graduation each student received the following results of the formation of digital competence (figure 6).

The leading idea of the research concept is reflected in the hypothesis based on the assumption: if the training of modern economists is carried out according to the proposed phased formation of digital intelligence skills, it will increase the levels of digital intelligence: "digital citizen", "digital entrepreneur" and "digital creator".

At the beginning of the pedagogical experiment, each student assessed their own level of competence in the components of digital intelligence in accordance with the developed indicators on a scale from 0 to 10 for the levels of "Digital Citizen", "Digital Creator", "Digital Entrepreneur". For each level, the average value of the formation of the corresponding component of digital intelligence was determined. After completing the training, in which students were offered resources, tasks, training practices for the formation of digital intelligence skills at different levels during three stages, students were asked to re-evaluate the level of formation of digital intelligence competencies. The results of the experiment for 3 academic years on the formation of competencies in digital intelligence at the levels of "Digital Citizen", "Digital Creator", "Digital Entrepreneur" are presented in tables 1-3.

To confirm the hypothesis of the study, a null hypothesis was put forward: the average value of the level of formation of digital intelligence before and after the experiment for each level does not differ. Deviation of this hypothesis for each level will confirm the effectiveness of the technologies used. The sample data have a normal distribution and form a pair of correlating values, whereas the paired Student t-test was chosen to evaluate the results.

Assessment of digital intelligence skills at the level of "Digital Citizen" is presented in table 1.

The sample data have a normal distribution and form a pair of correlating values, whereas the paired

Table 1: Assessment of digital intelligence skills at the level of "Digital Citizen".

Components of digital intelligence	Sampling		Deviation from the average	
	To	After	To	After
DI1	4.78	7.94	0.26	1.14
DI2	3.95	6.33	-0.57	-0.47
DI3	3.70	5.67	-0.82	-1.13
DI4	5.69	7.27	1.17	0.47
DI5	4.26	7.41	-0.26	0.61
DI6	3.81	5.27	-0.71	-1.53
DI7	4.86	7.84	0.34	1.04
DI8	5.13	6.67	0.61	-0.13
$\sum$	36.18	54.40	0.02	0.00
Average value	4.52	6.80		

Table 2: Assessment of digital intelligence skills at the level of "Digital Creator".

Components of digital intelligence	Sampling		Deviation from the average	
	To	After	To	After
DI1	2.91	5.35	-0.07	-0.36
DI2	2.85	5.53	-0.13	-0.18
DI3	1.78	5.33	-1.20	-0.38
DI4	2.98	5.58	0.00	-0.13
DI5	1.97	5.50	-1.01	-0.21
DI6	3.98	5.92	1.00	0.21
DI7	3.47	6.29	0.49	0.58
DI8	3.86	6.18	0.88	0.47
$\sum$	23.80	45.68	-0.04	0.00
Average value	2.98	5.71		

Student t-test was chosen to evaluate the results. The t-criterion was calculated by the formula $t = \frac{|M_d|}{\frac{S_d}{\sqrt{N}}}$, where M_d – is the mean difference of the values, S_d – standard deviation, N – the number of parameters. The estimated t-criterion is 8.7, the critical value of the Student's t-criterion for the number of degrees of freedom 7 is 2.365. Since t-estimated $>$ t-critical, we can reject the null hypothesis and conclude that the difference in average values before and after the experiment is statistically significant ($p = 0.05$).

As can be seen from table 1, students have increased the level of skills "Digital Citizen" as a result of studying the proposed courses by an average on 22.8%. Graphical interpretation of the results of the experiment for the level of "Digital Citizen" are given in figure 7.

Assessment of digital intelligence skills at the level of "Digital Creator" is presented in table 2.

The estimated t-criterion is 2.534 and exceeds the

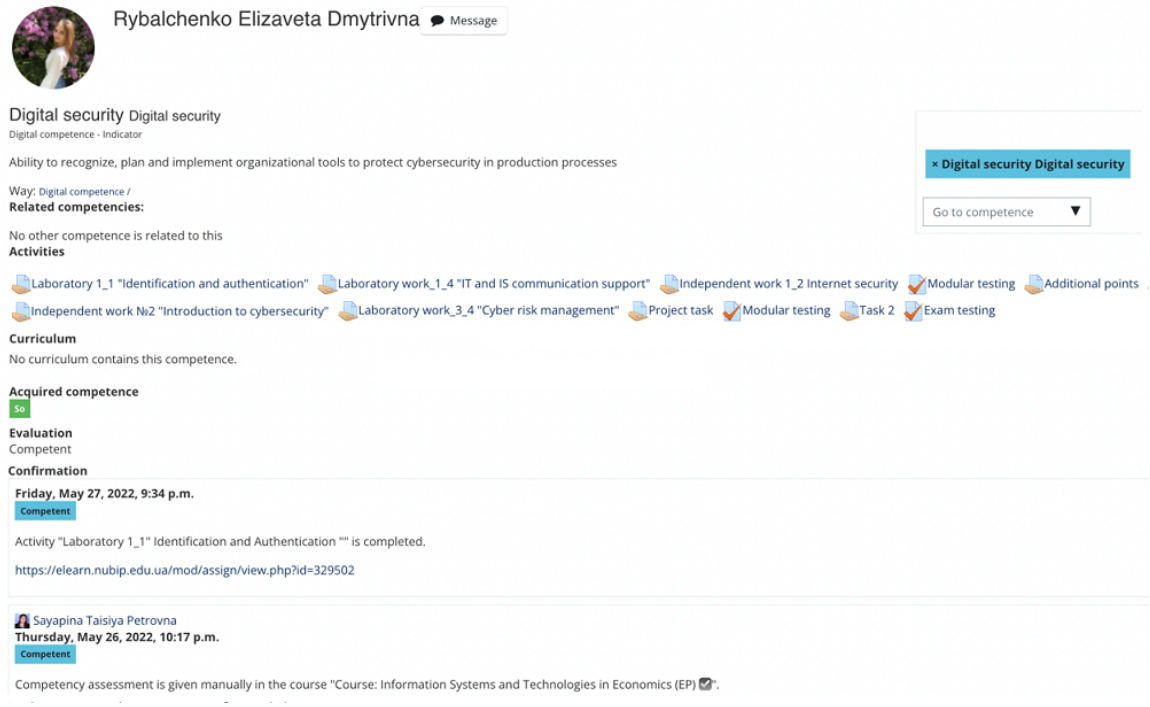

Figure 6: Distribution of competencies by student.

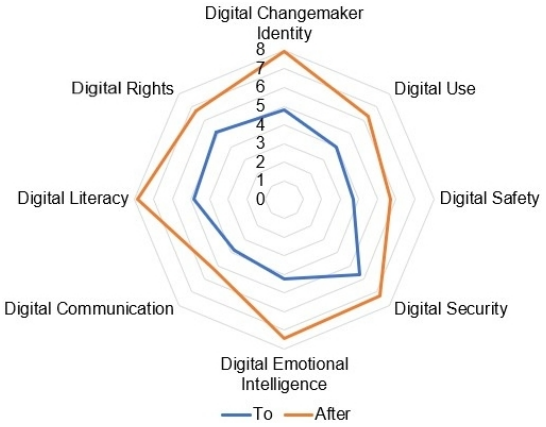

Figure 7: Graphical interpretation of digital intelligence skills at the level of "Digital Citizen".

t-critical, we can reject the null hypothesis and conclude that the difference in average values before and after the experiment is statistically significant ($p = 0.05$).

As can be seen from table 2, students increased the level of skills of "Digital Creator" as a result of project tasks by an average of 27.3%. Graphical interpretation of the results of the experiment for the level of "Digital Creator" are given in figure 8.

Assessment of digital intelligence skills at the level of "Digital Entrepreneur" is presented in table 3.

The estimated t-criterion is 7.22 and exceeds the

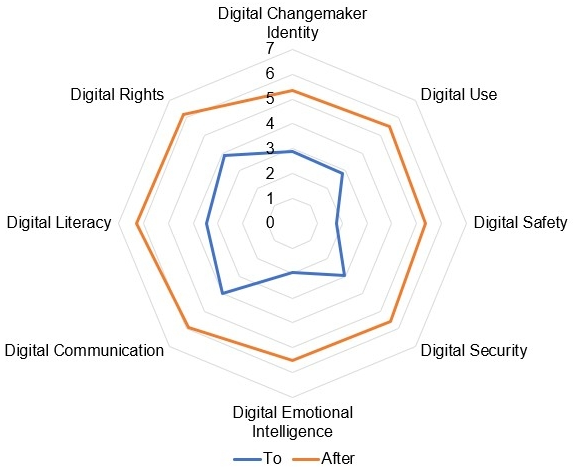

Figure 8: Graphical interpretation of digital intelligence skills at the level of "Digital Creator".

t-critical, we can reject the null hypothesis and conclude that the difference in average values before and after the experiment is statistically significant ($p = 0.05$). As can be seen from table 3, students have increased the level of skills "Digital Entrepreneur" as a result of internships by an average of 23.6%. Graphical interpretation of the results of the experiment for the level of "Digital Entrepreneur" are given in figure 9.

In the results of the experiment in the first, sec-

Table 3: Assessment of digital intelligence skills at the level of “Digital Entrepreneur”.

Components of digital intelligence	Sampling		Deviation from the average	
	To	After	To	After
DI1	3.44	6.37	-0.13	0.46
DI2	2.88	6.16	-0.69	0.25
DI3	3.65	5.45	0.08	-0.46
DI4	3.64	5.96	0.07	0.05
DI5	2.98	5.91	-0.59	0.00
DI6	4.16	5.30	0.59	-0.61
DI7	2.55	5.85	-1.02	-0.06
DI8	5.26	6.31	1.69	0.40
Σ	28.56	47.31	0.00	0.03
Average value	3.57	5,91		

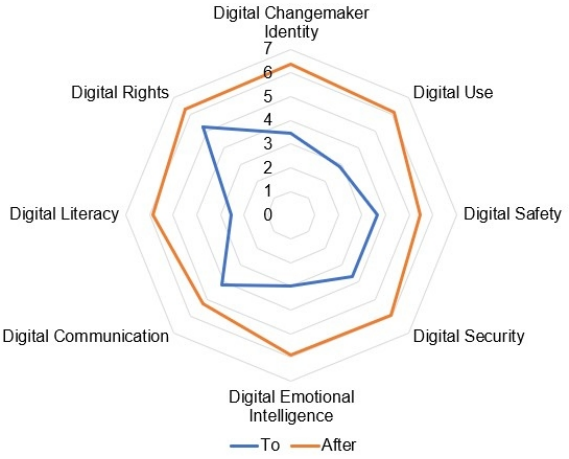

Figure 9: Graphical interpretation of the results for the level of “Digital Entrepreneur”.

ond and third stages, presented in figures 7-9, and in tables 1-3, we observe the heterogeneity of the indicators of the formation of digital intelligence skills for different components. After the first stage, the highest level of DI is observed for the components of digital identity, security, emotional intelligence, and digital literacy, which we explain by additional thematic MOOCs and by the using of appropriately selected resources and services for training skills, matched the specified DI components. For the development of other DI components for the level of Citizen, other professionally-oriented courses are provided, during which these skills will be developed, for example, the discipline “DBMS”. For the levels Creator and Entrepreneur levels, the level of skills formation with different elements is connatural, which is explained by the formation of competency and practice-oriented tasks considering the development of all components of DE, applying blended learning technology, which included project work methods, case method, individual and teamwork. Achieving the maximum values of the corresponding indicators of the digital intelligence is expected during the study of other professionally-oriented disciplines.

5 CONCLUSIONS

The analytical study made it possible to identify and describe the following components of the digital intelligence of the economist: Digital Changemaker Identity, Digital Use, Digital Safety, Digital Security, Digital Emotional Intelligence, Digital Communication, Digital Literacy, Digital Rights. The content of the Information Systems and Technologies academic discipline for training future economists at universities, in which digital intelligence skills can be developed, is proposed.

The developed approach gives the possibility to formulate digital intelligence skills of the digital citizen, digital creator and digital entrepreneur levels. The essence of the approach lies in the step-by-step formation of skills that correspond to each successive level. The initial stage involves studying the educational material and performing a series of hands-on classes within the disciplines. In this way, digital citizen skills can be formed. The second stage is to carry out a project work that requires creativity to solve the project task, and as a result, future economists will develop the skills of the Digital creator level. The third stage involves the fulfillment of a real production situation, which requires the student not only to have previously acquired knowledge, skills and their application in practice, but also to gain new experience in solving typical production situations and responding to appropriate challenges. This stage is designed to build students’ Digital entrepreneur skills.

A formalized approach to the formation of tasks in the elearning course in accordance with the components of digital intelligence (DQ) using the built-in tools of the moodle platform, provides an opportunity to improve the learning process of students in accordance with the objectives of competencies.

Three-stage approach of forming skills of digital intelligence was tested for three years to train students in “Economics”. As a result of pedagogical experiment, the level of digital intelligence skills has been increased, in particular, the level of “digital citizen” increases by 22.8%, the level of “digital creator” by 27.3% and the level of “digital entrepreneur” by 23.6%. The obtained results show that under the given conditions of the organization of training during studying of educational course Information Systems and Technology in Economics at students of eco-

nomic specialties the level of digital intelligence increases on the average by 24.4%. But the development of digital intelligence of future economists is carried out in the future during the study of vocational courses, internships, diploma design, as well as through non-formal education.

Among the perspective areas of research, we see the definition of conditions and construction of models of individual educational trajectory for students of economic specialties in order to effectively develop their digital intelligence.

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