

Digital Transformation in Education: Model for Higher Educational Institutions

Nataliia V. Morze¹ ^a and Oksana V. Strutynska² ^b

¹*Borys Grinchenko Kyiv University, 18/2 Bulvarno-Kudriavska Str., Kyiv, 04053, Ukraine*

²*National Pedagogical Dragomanov University, 9 Pyrogova Str., Kyiv, 01601, Ukraine*

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, in-

crease 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;

^a  <https://orcid.org/0000-0003-3477-9254>

^b  <https://orcid.org/0000-0003-3555-070X>

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 digitization 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

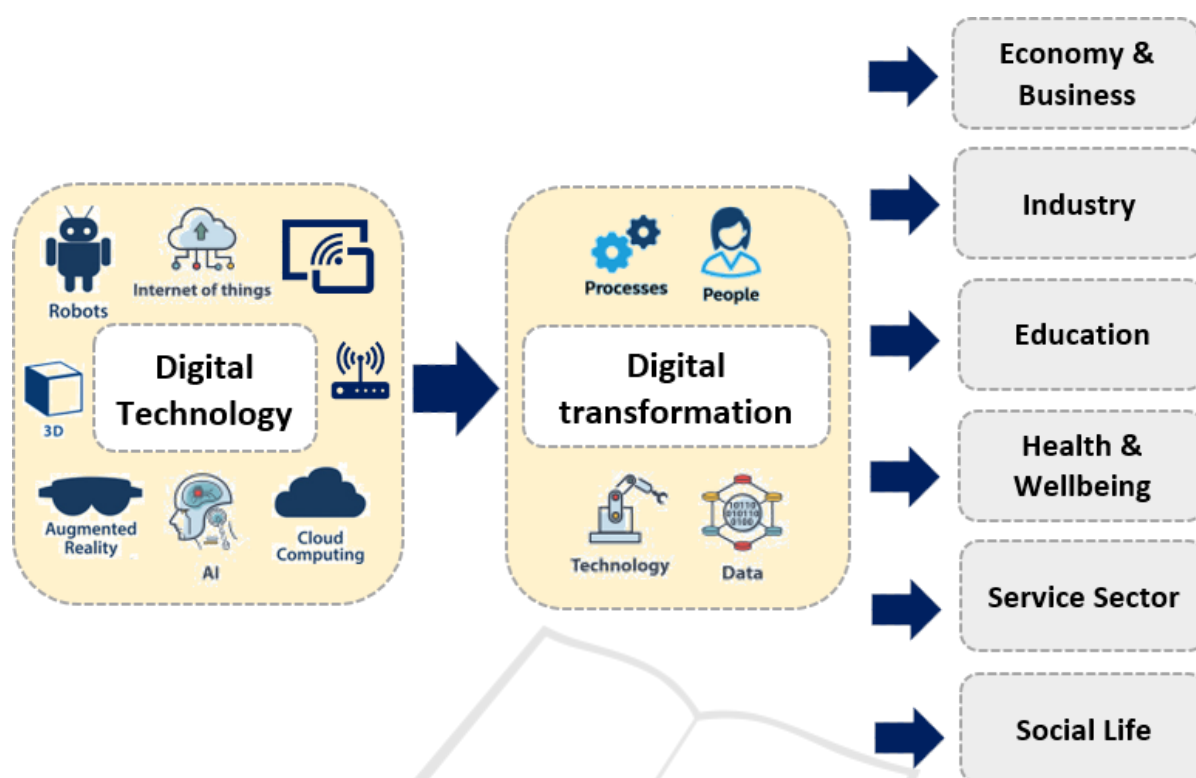


Figure 1: Areas in which fundamental changes take place due to the digital transformation (Morze and Strutynska, 2021)

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 stu-

dents 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.

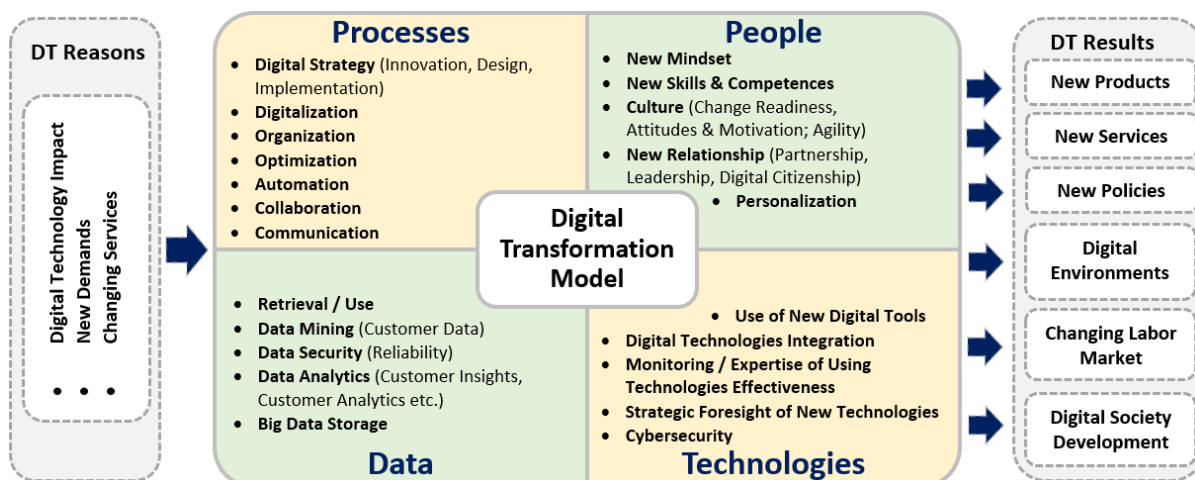


Figure 2: Digital Transformation Model (Morze and Strutyńska, 2021).

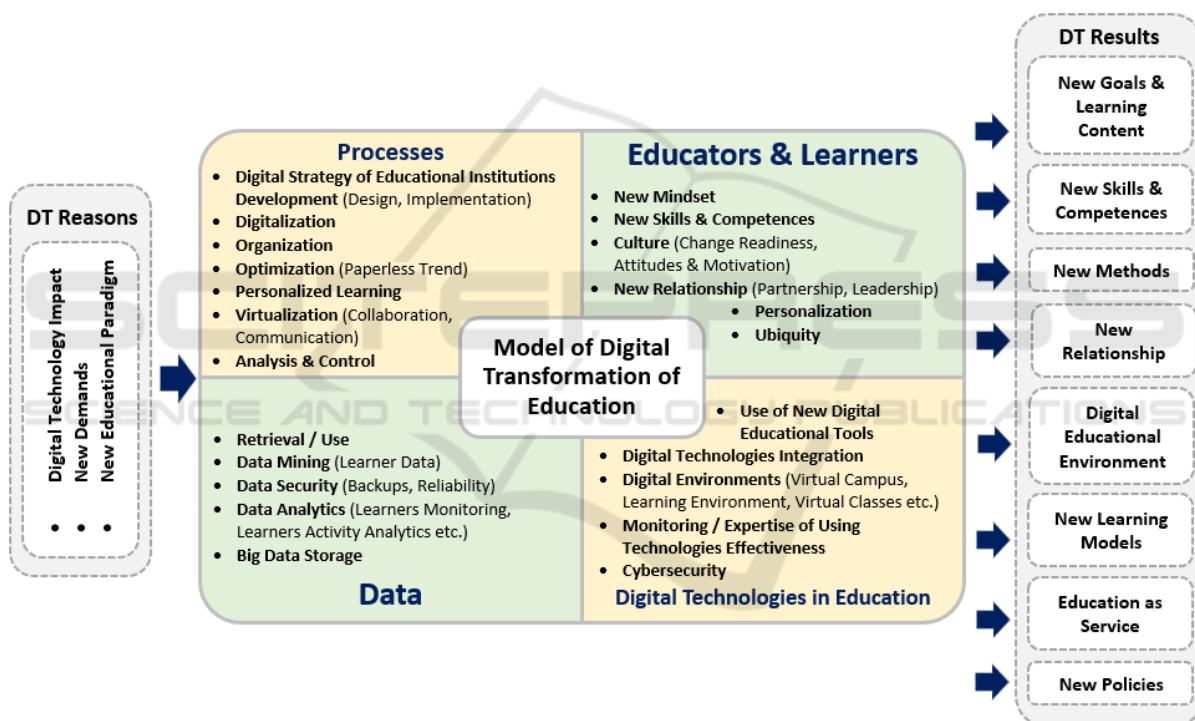


Figure 3: Model of Digital Transformation of Education

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

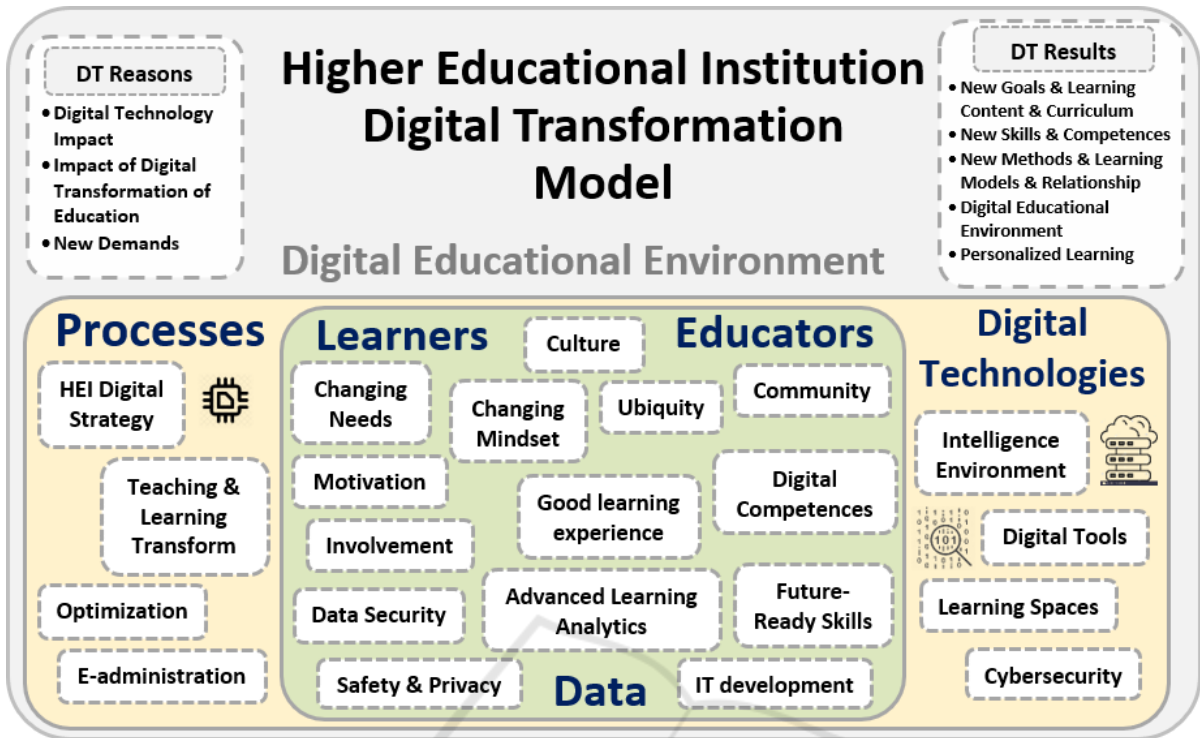


Figure 4: Higher Educational Institution Digital Transformation Model.

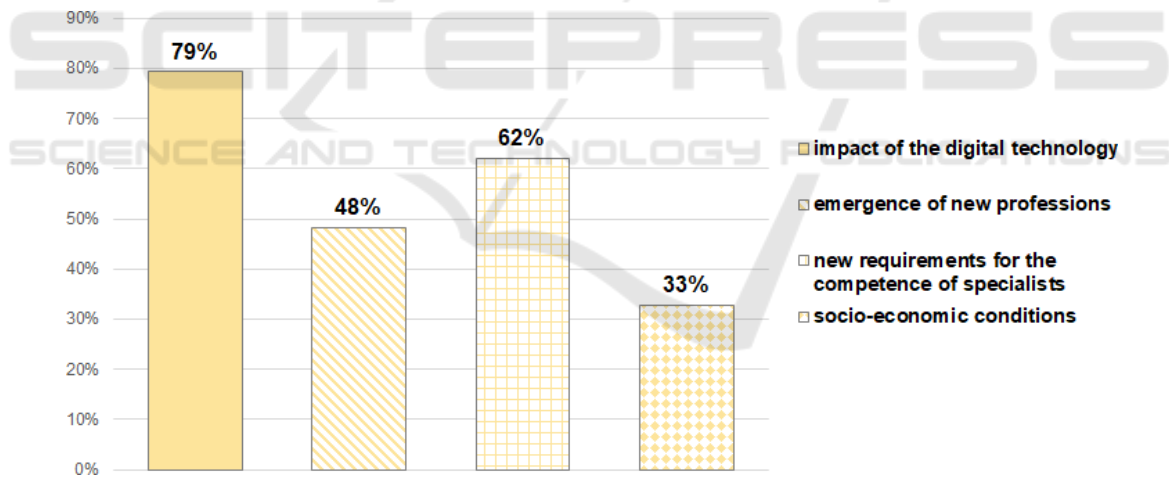


Figure 5: Survey responses on the causes the digital transformation of education.

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.

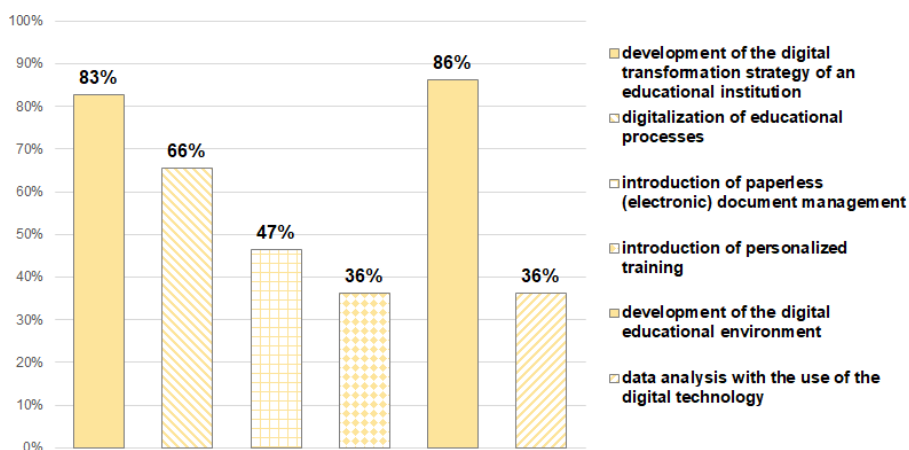


Figure 6: Survey responses on processes need to be implemented for the digital transformation of education.

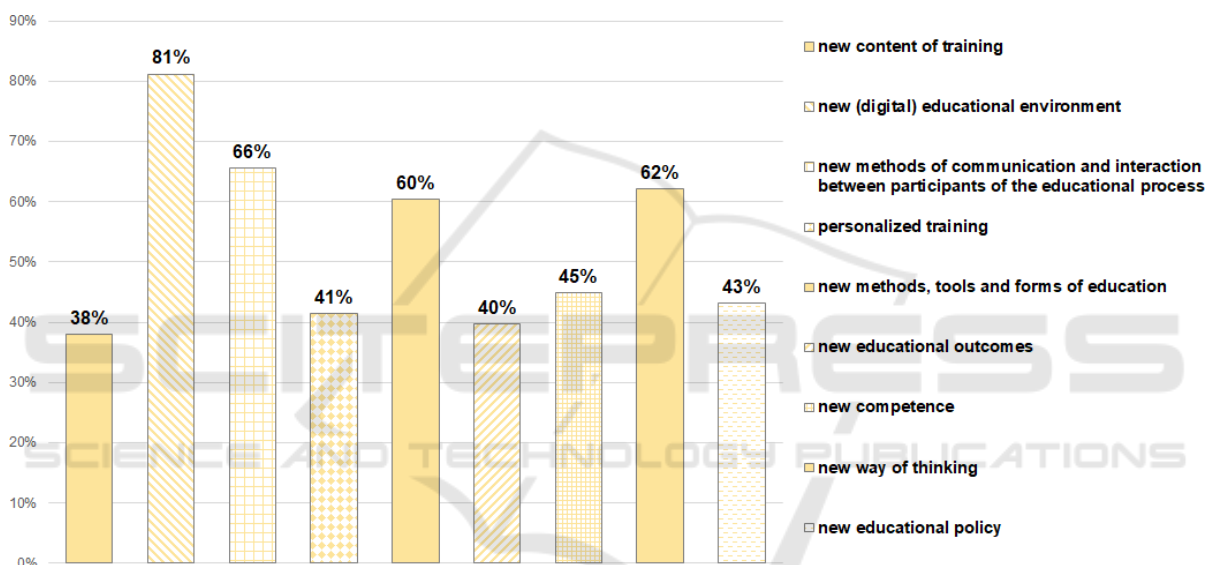


Figure 7: Survey responses on respondents' opinion about results from the digital transformation of education.

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-

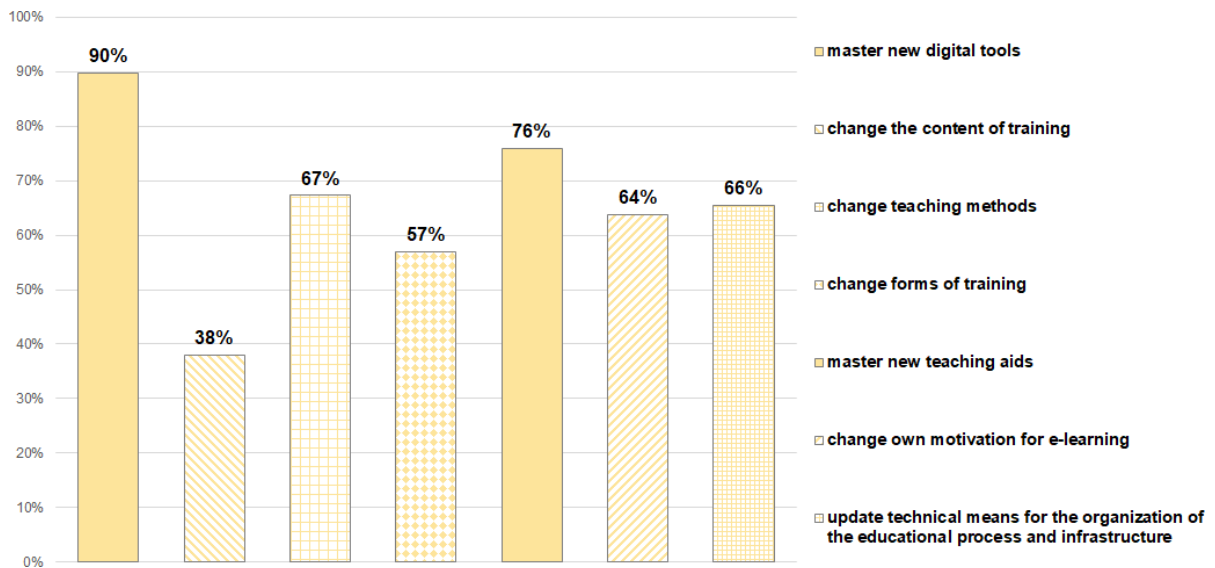


Figure 8: Survey responses on respondents' opinion about what teachers need to do to implement an effective educational process under the conditions of the digital transformation.

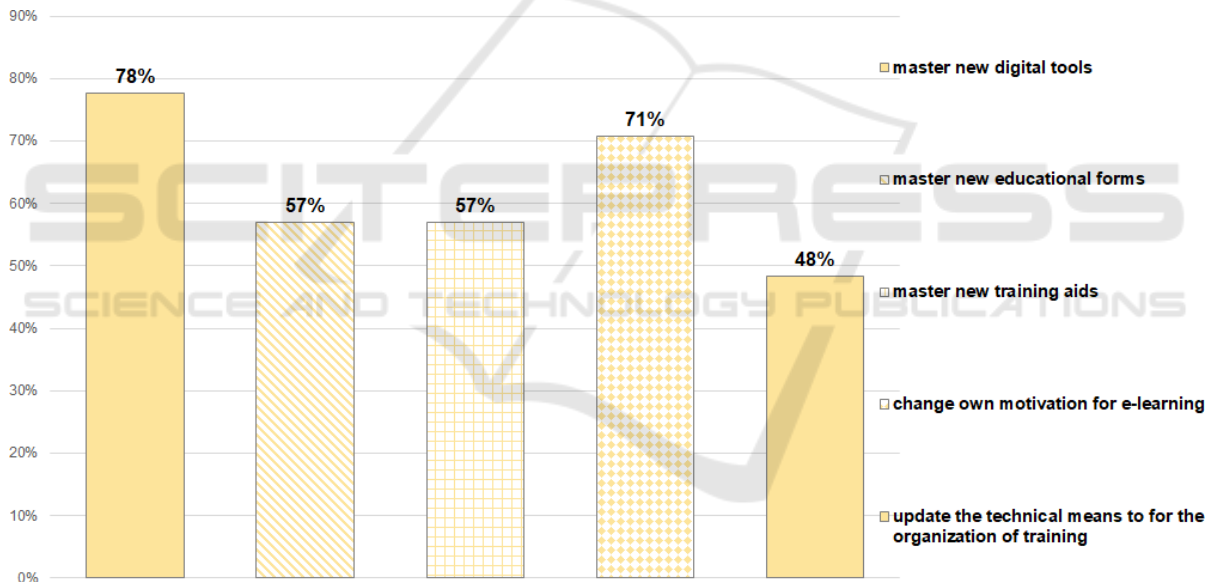


Figure 9: Survey responses on respondents' opinion about what students need to do for studying under the conditions of the digital transformation.

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.

REFERENCES

- (2017). Digital Transformation in Higher Education. Report, Navitas Ventures. <https://moodle.ufsc.br/mod/resource/view.php?id=1741051>.
- Bumann, J. and Peter, M. K. (2019). Action Fields of Digital Transformation - A Review and Comparative Analysis of Digital Transformation maturity Models and Frameworks. In Verkuil, A. H., Hinkelmann, K., and Aeschbacher, M., editors, *Digitalisierung und andere Innovationsformen im Management: aktuelle Perspektiven auf die digitale Transformation von Unternehmen und Lebenswelten*, volume 2 of *Innovation und Unternehmertum*, pages 13–40. Edition Gesowip, Basel. <https://www.researchgate.net/publication/337167323>.
- European Union (2020). *The Digital Education Action Plan 2021-2027: Resetting education and training for the digital age*. https://ec.europa.eu/education/sites/education/files/document-library-docs/deap-communication-sept2020_en.pdf.
- Ford, F. R. and Lobo, I. (2017). Digital disruption: Development unleashed. Multiply innovation, collaboration and impact through digital in international development. <https://tinyurl.com/yc6j5ybv>.
- HolonIQ (2020). *Higher Education Digital Capability Framework*. <https://www.digitalcapability.org>.
- Hrynevych, L. M., Ilich, L. M., Lynov, K. O., Viktorivna, M. N., Protsenko, O. B., Proshkin, V. V., Rii, H. Y., and Shemelynets, I. I. (2020). Orhanizatsiia osvithnoho protsesu v shkolakh Ukrainy v umovakh karantynu [Organization of the educational process in schools of Ukraine in quarantine]. Analytical note, Borys Grinchenko Kyiv University, Kyiv. <https://tinyurl.com/yxv5nx8x>.
- i-SCOOP (2021). *What is digital business transformation? The essential guide to DX*. <https://www.i-scoop.eu/digital-transformation>.
- Mergel, I., Edelman, N., and Haug, N. (2019). Defining digital transformation: Results from expert interviews. *Government Information Quarterly*, 36(4):101385. <https://doi.org/10.1016/j.giq.2019.06.002>.
- Morze, N., Kucherovska, V., and Smyrnova-Trybulska, E. (2020). Self-estimation of an educational institution's digitalization level under the conditions of secondary education transformation. *Electronic Scientific Professional Journal "OPEN EDUCATIONAL E-ENVIRONMENT OF MODERN UNIVERSITY"*, (8):72–87. <https://doi.org/10.28925/2414-0325.2020.8.8>.
- Morze, N. V. and Strutynska, O. V. (2021). Digital transformation in society: key aspects for model development. *Journal of Physics: Conference Series*, 1946(1):012021. <https://doi.org/10.1088/1742-6596/1946/1/012021>.
- Muluk, T. (2016). ICT in Education for Digital Transformation. In *ITU Regional Workshop for CIS on "Strengthening Capacity Building in the field of Telecommunications/ICT"*. <https://www.itu.int/en/ITU-D/Regional-Presence/CIS/Documents/Events/2017/04-Odessa/Presentations/ITU%20Workshop%2012.04-Turhan%20Muluk.pdf>.
- Negroponte, N. (1995). *Being Digital*. Hodder & Stoughton, London. <https://archive.org/details/beingdigital000negr>.
- Nguyen, D. (2018). The university in a world of digital technologies: Tensions and challenges. *Australasian Marketing Journal (AMJ)*, 26(2):79–82. <https://doi.org/10.1016/j.ausmj.2018.05.012>.
- OECD and European Union (2019). Digital transformation and capabilities. In *Supporting Entrepreneurship and Innovation in Higher Education in Italy*, chapter 5, pages 125–145. OECD Publishing, Paris. <https://doi.org/10.1787/6cc2e0a5-en>.
- Patton, R. and Santos, R. (2018). The next-generation digital learning environment and a framework for change for education institutions. White paper, Cisco. https://www.cisco.com/c/dam/en_us/solutions/industries/docs/education/digital-learning-environment.pdf.
- Pawlowski, J. M. (2019). Digital Transformation - how to survive in the age of Digitization. Conference New Pedagogical Approaches in STEAM Education. September 26-27, 2019. Kyiv (Ukraine).
- Rof, A., Bikfalvi, A., and Marquès, P. (2020). Digital Transformation for Business Model Innovation in Higher

- Education: Overcoming the Tensions. *Sustainability*, 12(12):4980. <https://doi.org/10.3390/su12124980>.
- Sepúlveda, A. (2020). *The digital transformation of education: connecting schools, empowering learners*. Geneva. <https://unesdoc.unesco.org/ark:/48223/pf0000374309>.
- Strutynska, O. (2020). Transformation of education under conditions of digital society development: European experience and prospects for Ukraine. *Scientific bulletin of South Ukrainian National Pedagogical University named after K. D. Ushynsky*, (3(132)):71–88. <https://doi.org/10.24195/2617-6688-2020-3-9>.
- Vishnevsky, V., Harkushenko, O., Kniaziev, S., Lypnyskyi, D., and Chekina, V. (2020). *Digitalization of Ukrainian economy: transformational potential*. Akadempriodyka, Kyiv. <https://www.researchgate.net/publication/339680125>.
- Westerman, G., Bonnet, D., and McAfee, A. (2014). The nine elements of digital transformation. <https://sloanreview.mit.edu/article/the-nine-elements-of-digital-transformation>.
- Wildan Zulfikar, M., Idham bin Hashim, A., Ubaid bin Ahmad Umri, H., and Ahmad Dahlan, A. R. (2018). A Business Case for Digital Transformation of a Malaysian-Based University. In *2018 International Conference on Information and Communication Technology for the Muslim World (ICT4M)*, pages 106–109. <https://doi.org/10.1109/ICT4M.2018.00028>.

