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Serhiy Semerikov
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FOREWORD

Myroslav I. Zhaldak Symposium on **Advances in Educational Technology** (AET) is a peer-reviewed international conference focusing on research advances and applications of combined use of computer hardware, software, and educational theory and practice to facilitate learning. Today, AET is the premier interdisciplinary forum for learning scientists, academicians, researchers, professionals, policymakers, postgraduate students, and practitioners to present their latest research results, ideas, developments, and applications.

AET topics of interest are:

- Artificial Intelligence, knowledge engineering, and intelligent tutoring systems
- Aspects of environmental augmented reality security and ethics
- Augmented reality gamification
- Augmented reality in professional training and retraining
- Augmented reality in science education
- Augmented reality social and technical issues
- Cloud technologies for informatics learning
- Cloud technologies for mathematics learning
- Cloud technologies for physics learning
- Cloud technologies of mobile learning
- Cloud technologies of open education
- Cloud-based and mobile learning technologies for teacher and VET
- Cloud-based e-learning platforms, tools and services
- Cloud-based learning environments
- Cloud-based learning management systems
- Computer simulation in science and mathematics learning
- Design and implementation of augmented reality learning environments
- Development of Soft Skills for teachers of institutions of professional, special before higher and higher education in the context of digitalization
- Educational data mining and learning analytics
- ICT in higher education for a sustainable future society
- ICT in secondary education for a sustainable future society
- Learning environments models
- Learning technology
- Machine learning, robot learning and artificial learning
- Management of professional development of specialists in the digital space of formal and non-formal education

- 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
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PAPERS

FULL PAPERS

The Role of Digital Competency in Educational Process of Participants When Designing a Digital Educational Environment

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Keywords: Digital Educational Environment, Educational Strategies, Digitization of Education, SELFIE Tool, Digital Skills, K-12 Educational Policy.

Abstract: Graduates' digital competency isn't a new demand. On the contrary, it is a necessity, which is a response to the world's tendencies. Not taking into account the fact that those concepts today are among the hottest topics, and the most asked questions, there is still a lack of practical research and use, the results received from practice. Measuring digital competency is a key task for educational institutions to keep following their current state and to respond to the issues in time. Having this information, educational institutions could create studying programs, which would provide personal and professional development for education applicants. That's why the research covers a theoretical overview of the tools needed for estimating digital competency, and the importance of creating an educational policy on digital technology usage is described. The importance of conducting surveys about digital competency levels is justified in this work as well.

1 INTRODUCTION

Today digitalization has become one of the most significant tendencies of civilization development. Digitalization of objects and attributes shapes inclusive society and contributes to the renewal of management mechanisms, giving continuous access to health protection, education, and the economic sector. It raises the quality and number of governmental services being included and broadens opportunities for cooperation for people. The pandemic of COVID-19 and the war in Ukraine have proved the importance and necessity of spreading and popularizing digital technologies for ensuring safety, equal access to informational sources, national well-being, and stability of economical processes.

A modern graduate of a secondary educational institution must be competitive, mobile, and ready for constant learning. Such demands must lead to the renovation of the structure and content of educational services given by institutions of secondary education. Using and mastering the newest forms of educational activity, the modernisation of educational approaches will contribute to forming competent specialists, who will meet the needs and demands of Industry 4.0. In its turn, Industry 4.0 provides an implementation of new digital solutions for the optimization of production systems. New development opportunities appear thanks to the connection between Industry 4.0 opportunities and educational transformations. Education of workers for connecting complex productive environments plays a key role. The main educational role is in the development of competencies, necessary for a competitive and changeable market. Digital competency is the main condition for transformation in the 4th Industrial Revolution.

Such challenges and demands of the time caused the need for approval and implementation of The Digital Competence Framework for Citizens in Ukraine (Ministry of Digital Transformation of Ukraine, 2021b). The Framework was adapted after a complex expert analysis counting on the results of projects and scientific works concerning the development of digital competency in Ukraine and outside its borders. The Framework is based on the European model DigComp 2.1, which is adapted for the national, cultural, educational, and economic features of the country.

Yet we can see that until now the essence of education has stayed still, and conditions of learning and teaching are being changed very slowly and too carefully. On the governmental level documents which are supposed to regulate the implementation and spreading of digital technologies are being used, although

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the system of their usage is still incomplete.

The *purpose* of the article is to define the role of digital competency of participants in the educational process in projecting a digital educational environment.

2 LITERATURE REVIEW

Nowadays the question of learning theoretical, methodological and methodical aspects of digital transformation of secondary education and the creation as well as effective usage of the digital policy in an educational institution is fairly actual and not fully explored and summarised in the realisation of the Concept of a New Ukrainian school (Elkin et al., 2017), renewed Law of Ukraine "On the full secondary education" (Verkhovna Rada of Ukraine, 2020) and Framework of digital competency for citizens (Ministry of Digital Transformation of Ukraine, 2021b).

Problems of digital education are at the center of the pedagogical community attention, as evidenced by numerous conceptual and thorough studies of foreign and domestic scientists.

Berawi et al. (Berawi et al., 2020) claim that the spread of innovations changes stable economic systems and causes structural changes in various areas. Innovations become the basis of the need for digitalization of society. According to authors, digital technologies are used to manage integrated product life cycles and improve efficient, reliable and sustainable business operations. Artificial intelligence, internet of things, machine learning, blockchain, big data and other digital technologies are creating new conditions for the development of economies.

Zawacki-Richter and Anderson (Zawacki-Richter and Anderson, 2014) gives advice on how to organize distance education describing the positive aspects of distance education practices such as: cost issues, social justice issues, cultural biases, etc.

Gillpatrick (Gillpatrick, 2020) believes that the key drivers for changing education are the rapid introduction of new digital technologies, the development of new educational delivery systems, economic models as well as changing educational expectations from a new generation of learners, digital natives.

Gavrilova and Voronova (Gavrilova and Voronova, 2018) describes the theoretical aspects of modern digital environment development. The scientists describes the importance of digital culture skills as an indicator of successful pedagogical activity in the structure of the digital environment.

Barna and Kuzminska (Barna and Kuzminska, 2020) notes that today's challenges accelerate the processes of transformation of educational institutions. They describe the importance of designing, applying and developing a digital educational environment, the degree of possession of digital competences by all participants of the educational process. Analyzes of indicators of the educational institution's readiness for digital transformation and tools for their assessment are conducted. Digitization of educational environments (unlike to informatization) involves a change in the implementation of educational business processes, the creation of new services and forms of interaction for maximum realization of the potential of the educational process subjects and ensuring the accelerated development and evolution of institutions, economy and the state.

Morze and Strutynska (Morze and Strutynska, 2021) analyses the digital transformation processes currently taking place in the economy, production, education and society as a whole. Scientists assume that the driver of digital transformation is the influence of digital technologies. One of the key issues for the implementation of digital transformation is changes in the way of thinking and requirements for the competences of employees in the industry. First of all, it is related to people's understanding of digital transformation processes and their ability to use digital technologies effectively.

Researchers of the problems of education transformation pay considerable attention to the management of the formation of the state educational policy and directions of its development, part of which is the educational policy in the field of the use of digital technologies. Methodological principles and various aspects of the implementation of the state educational policy in the field of education management were studied by Karim (Karim, 2021). The author described the stages of design and implementation of the development of educational policy and practice in a globalized world

Hardy et al. (Hardy et al., 2021) describes Finland's experience from reforms to real implementation.

Separate issues of the digital transformation of educational policy highlighted in (Kuzminska and Nanaieva, 2016; Sych et al., 2021).

3 RESEARCH RESULTS

In 2021 the Concept of the development of digital competences was accepted (Cabinet of Ministers of Ukraine, 2021). This move was more than just necessary, as the absence of conceptual basics of how to

form educational policy in the digitalization sphere doesn't allow to provide the development of other spheres according to modern demands, tendencies, and processes of global economic digitalization. The concept is made for solving specific tasks:

- defining law regulation of aspects of digital competencies;
- forming demands and descriptions for necessary digital competencies;
- renewing professional standards;
- shaping demands for digital competencies in educational institutions;
- creating an indication system for monitoring the development of digital skills and digital competencies;
- coordination of actions for the realization of governmental policy in the sphere of digital development and digital competencies.

The main obstacle on the way to creating digital transformation of the educational process is the lack of understanding of where to start, the absence of a systematic view and understanding of necessary and sufficient measures for a successful digital transformation as such. As the perspective of radical changes can be deceitful, it is important to understand which strategy to choose and how to develop an effective educational policy in the digital sphere and create a quality educational environment. Conduction of studies on the digital literacy of education applicants, graduates, pedagogical workers, and managers will contribute to the search for the right way for creating educational policies.

The approval of the Framework of digital competencies for citizens (Ministry of Digital Transformation of Ukraine, 2021b) makes demands for all the participants in the educational process as the basics of computer literacy, information literacy, the ability to work with data, creating digital content, communication and interaction in a digital society, digital safety, problem-solving in a digital society and lifelong learning are the competencies everybody working in educational sphere needs. Measures, described in the Framework, are wholesome and in one way or another, they define the necessary set of skills for teachers, students and managers. Those skills are necessary for both domestic and professional aspects. Usage of the Framework forwards adding and changing professional standards and demands for positions, also the creation of the programs for studies, training, and educational resources. Creating detailed professional Frameworks will contribute to increasing competitiveness and the level of giving services.

The Ministry of digital transformation of Ukraine together with the Ministry of Education and Science of Ukraine has created a project called "Conceptual referent Framework of digital competency of pedagogical and scientifically pedagogical workers" (Ministry of Digital Transformation of Ukraine, 2021a). The European model of Framework for educators called "The Digital Competence Framework for Educators" (DigCompEdu) is the base of the Ukrainian one (European Commission et al., 2017). The Framework for educators includes 5 measures, 5 spheres, 22 competencies and 5 levels of owning. It characterises digital technology in education as a transformed environment, which gives extended possibilities for learning without borders in time and location. Thanks to using the Framework comes up the opportunity of projecting individual education trajectories for educational applicants. New approaches for using technologies will contribute to a faster change from simple consumption of electronic resources to their creation. According to the approach described in the Framework, the teacher becomes a guide in the digital world instead of being a library full of knowledge as it used to be. Therefore, it becomes a push for increasing the level of personal competencies for teachers and managers of educational institutions.

Poor level of digital competency among teachers makes the process of forming high competency among students much slower. The results of the digital competency level made by the Ministry of digital transformation in 2021 (Ministry of Digital Transformation of Ukraine, 2021c) showed that almost 30 % of studying youngsters in the secondary educational institution system, 14 % in the secondary special education system and 3 % in unfinished higher education don't have basic digital skills and 39.4 %, 47.2 %, 26.7 % accordingly have skills on the level lower than medium.

In 2019 (Ministry of Digital Transformation of Ukraine, 2019) for the first time in the history of Ukraine, there was a sociological survey of the digital skills of citizens. After getting the results, the design of a National online platform for developing digital literacy started. Thus for today, we have already formed a certain bank of National testing for digital literacy (Ministry of Digital Transformation of Ukraine, 2023):

- Digigram 1.0 for citizens;
- Digigram 2.0 for citizen;
- For government workers;
- For medical workers;
- For teachers;
- ICDL Ukrainian digital citizen.

Digigram is a national test for estimating digital competencies. It consists of 90 questions. The tasks of the test are gathered according to the spheres of knowledge from the European The Digital Competence Framework for Citizens of DigComp 2.1. (Carretero et al., 2017), adapted by Ukrainian experts.

In 2021 (Ministry of Digital Transformation of Ukraine, 2021c) there was a repeated survey of digital literacy done among Ukrainians, and the following results were received. The questionnaire was held among 1800 respondents from 18 to 70 y.o. as a face-to-face interview, 410 respondents from 17 y.o. in an online format, 401 respondents from occupied territories of Donetsk and Luhansk region from 18 to 60 as a face-to-face interview, 349 respondents with hearing problems as an online questionnaire, and also 8 groups of respondents of other categories, specifically workers of medical sphere (doctors), educational sphere (teachers), local authorities and communal services sphere, elderly people (people of 60 and more years). For comparison, in 2019, the sample consisted of the following respondents: 1800 respondents from 18 to 70 y.o. as a face-to-face interview, 859 people from 10 to 17 as a face-to-face interview, 400 respondents from occupied territories of Donetsk and Luhansk region from 18 to 70 as a face-to-face interview, 219 respondents from 18 to 59 respondents with hearing problems as a questionnaire.

In the new research, we can see the dynamics of changes, the majority of which move to improvement. This way for the period of the 2019-2021 years the part of people who have Internet access rose by 4 %. The situation in 2021 was that 92 % of respondents had access to the web. For the majority of participants who didn't have access, the access wasn't considered a necessity.

Compared to 2019 (Ministry of Digital Transformation of Ukraine, 2019) the part of those who don't set Internet at home because of not being able to use it has shrunk by 17 %. We can see a decrease among respondents who have the "No skills" category and, as an outcome, the number of people with levels identified as "Basic" and higher, increases.

Dynamics of increase of digital skills is visible according to the next parameters:

- 36.8 % skills of creating digital content (+6.7 %);
- 79.2 % communicative skills (+3.5 %);
- 78.9 % informational skills (+2.8 %);
- 55,8 % skills of solving life problems (+2.6 %).

It is worth mentioning that from 2019 (Ministry of Digital Transformation of Ukraine, 2019) the most developed skills have been informational and communicative. Demand for digital skills is partially caused by increasing the number of people who within the last year faced problems connected to safety because of using the internet. Compared to the year 2019, the percentage of victims increased almost by 12 % and became 45.7 % of participants. From them, 37.3 % of Ukrainians faced fishing last year, and 18 % faced farming. A positive conclusion is the fact that almost half more people compared to 2019 (Ministry of Digital Transformation of Ukraine, 2019) became more careful and aware while using the Internet.

According to the research from 2019 (Ministry of Digital Transformation of Ukraine, 2019), 53 % of the population of Ukraine had digital skills lower than a basic level, in 2021 shrunk by 5.2 % or 1.42 million people and now is 47.8 %.

The percentage of people who used the Internet within the last 3 months at the moment of the survey was 88 % of the respondents, and 93 % of them did it almost every day. The most popular place for using the Internet was and stays home (89 % of Ukrainians), second place is work and place of study. The leader device for using the Internet is still a smartphone.

52 % of participants mention that they tried online tools, the most spread of which are applications for buying goods online, monitoring news on the Internet, and remote working for the first time during COVID-19. The third part of the respondents mentioned that since the pandemic started, they began spending more time online. 53 % of asked Ukrainians aged from 18 to 70 y.o. buy things online and this indicator is 13 % higher than in 2019 (Ministry of Digital Transformation of Ukraine, 2019). Most people buy clothes, and domestic goods and make regular payments.

An average Ukrainian spends approximately 3 hours 50 minutes online during the weekdays and 4 hours 05 minutes at the weekend.

8 from 10 of the participants think that using the Internet has more advantages than disadvantages, and 44.4 % are interested in improving their digital skills. The most interested in learning is the group of young people from 10 to 29 years old. Respondents are interested in learning the basics of online safety, quick and efficient searching for information on the net, being able to differentiate between reliable and non-reliable sources and using online banking services.

Therefore, there is a need in ensuring that society is ready for gaining the key competencies for the digital technologies sphere. Experience shows, that for the development of the digital competency of stakeholders in the educational process the sufficient condition is creating a digital educational environment, effective usage of which will lead to ensuring the quality of the results of educational activities of students.

The educational policy can fasten the progress of renewing approaches to using digital educational technologies. A clear plan for all the interaction levels will contribute to broadening the opportunities of educators for using digital technologies which help their professional activity.

For creating educational policy, it is essential to define the outer and inner components of the educational environment and tools to use, the efficient way for interaction between the participants of the educational process and the way of coordination, management, and estimation of the results. It is important to note that such activity isn't limited to working on an educational institution's territory, on the contrary, it continues to exist outside of those institutions, thanks to digital tools as well as other tools.

Based on scientific research analysis (Kulesz, 2017) we created a model showing the ways of projecting a digital educational environment (figure 1).

Relying on the model and The Digital Competence Framework for Citizens (Ministry of Digital Transformation of Ukraine, 2021b), we can create an algorithm for the implementation of digital educational policy in a secondary school institution (figure 2).

Innovations have great potential for ensuring the quality of educational programs, although participants of the educational process may not be ready for the integration of the technologies and not have corresponding knowledge and skills for using them. Successful usage of digital technologies in an educational program relies on teachers' and managers' readiness for accepting changes (Intel, 2019).

The world has already got different resources and tools for estimating the digital competency level. For instance, MyDigiSkills, Wheel of digital competency, Digital Skills and Jobs Platform, Digigram, and SELFIE.

MyDigiSkills is a tool allowing to define the level of digital competency based on each of five areas of the European system of The Digital Competence Framework for Citizens (DigComp) (Carretero et al., 2017):

- Informational literacy and data literacy;
- Communication and cooperation;
- Creating digital content;
- Safety;
- Problem solving.

The resource is available in Ukrainian, and the online questioning lasts for about 20 minutes and consists of 82 questions approximately.

The Wheel of digital competency is an online test for defining digital competency. It is available in English. The Wheel is designed by the Digital competency centre. The purpose of the survey is to create an understanding of the level of personal digital competency and to suggest resources for further development. The Wheel of digital competency is also theoretically based on an exploratory project of EU DigComp (Carretero et al., 2017).

Digital Skills and Jobs Platform is an online platform with an opportunity to estimate the digital competency level. According to the conclusions of the survey, there is an opportunity to create a road map for the development of your competencies based on interests and goals, and afterwards, there is the possibility of taking such a course on the platform.

From the point of view of the analysis of secondary educational institutions, therefore the main step before designing ICT policy should be the SELFIE tool (JRC et al., 2021), using which is, in our opinion, a necessary condition for creating an educational institution's outer policy in the sphere of digitalization of educational environment.

SELFIE is a free online tool, which helps schools estimate their usage of digital technologies for innovative and effective learning. This process of self-evaluation helps to start a dialogue about potential directions for development at schools. Thanks to SELFIE, schools can make a short description of where they stand in using digital technologies, taking into account boards of teachers, students and class tutors (JRC et al., 2021).

Usage of SELFIE by educational institutions is an important tool of the algorithm for implementing a digital policy of an educational institution. SELFIE lets schools find key problems in digitalization, form the ways of their solving, and set specific goals for key indicators of efficiency.

During 2020-2021 ninety-one educational institutions piloted SELFIE. The general quantity of respondents was 12714, 10447 were students, 1899 teachers and 368 institutions managers. 1193 primary educational institutions, 10592 secondary school institutions, and 929 professional education institutions took part in the experiment. The average level of digital preparation of participants, which went through the survey, was 7.97 (figure 3).

The highest indicator of preparations was seen among the managers of the institutions, average – of 8,81, although the teachers also showed a fairly high result of 8.25. The students showed an average result, which was 7.89 (figure 4).

Among educational institutions, the highest level is seen in professional educational institutions – 8.30. Almost equal data is seen among the primary educational institutions and secondary educational institu-

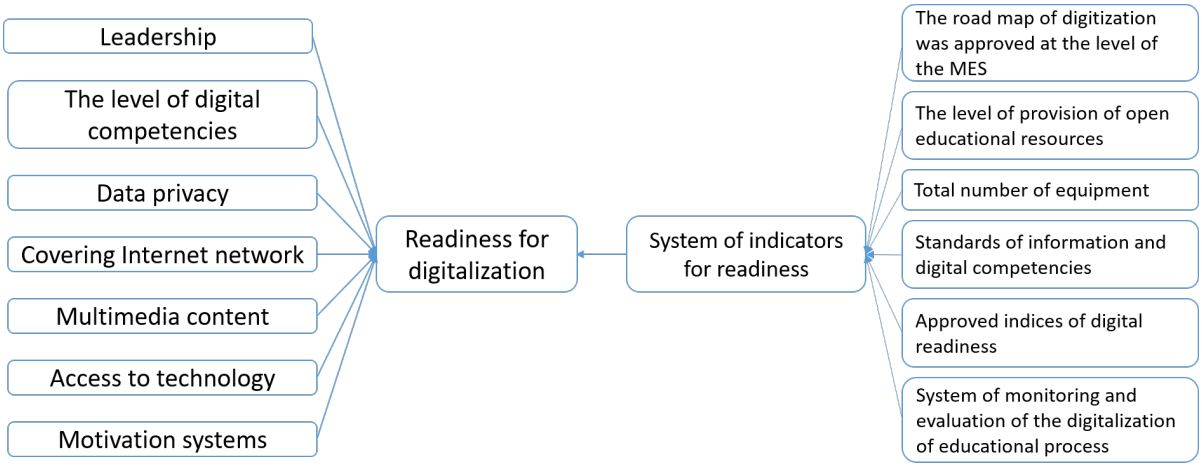

Figure 1: A model of projecting a digital educational environment.

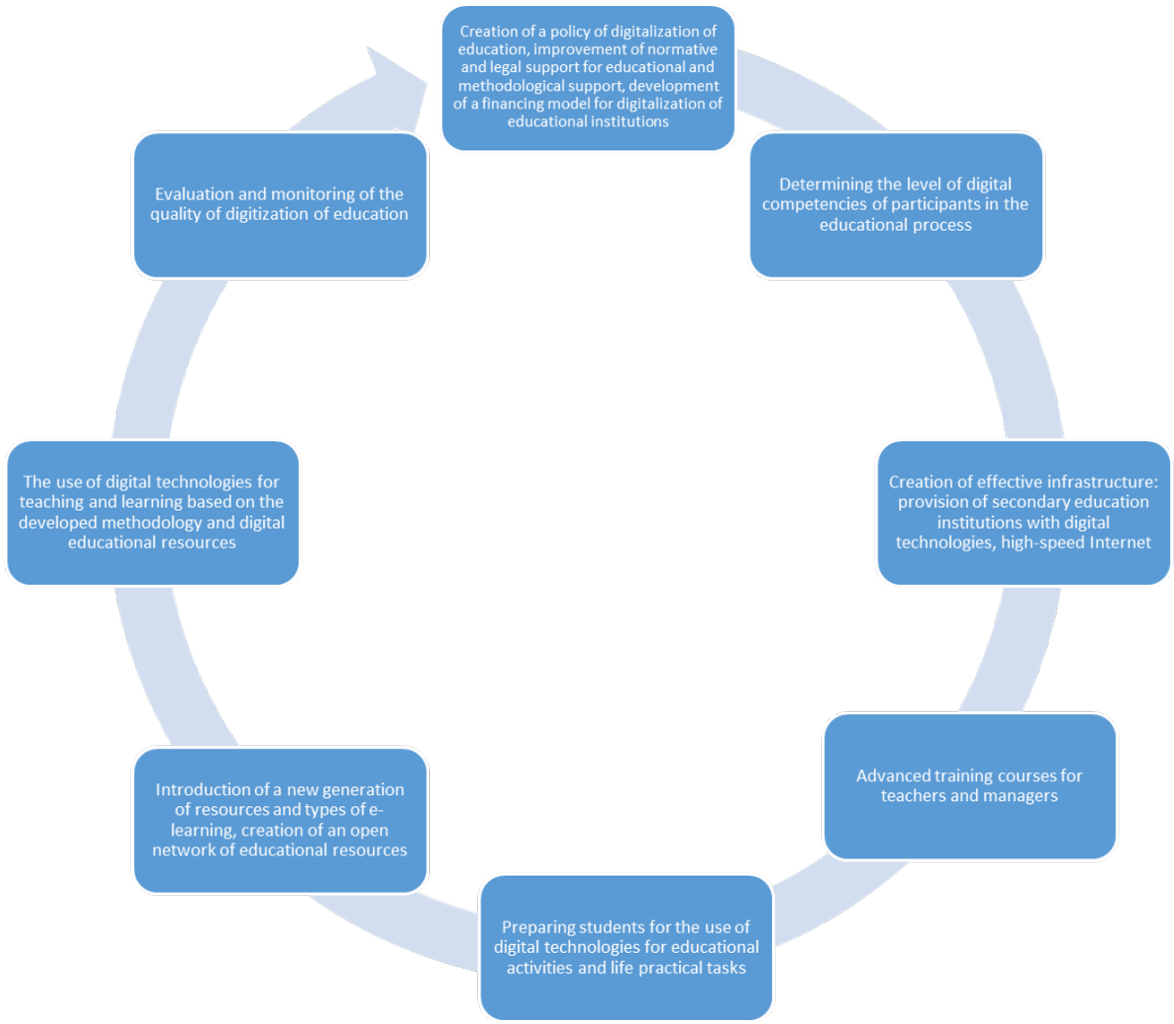

Figure 2: Steps for implementing digital educational policy into secondary educational institutions.

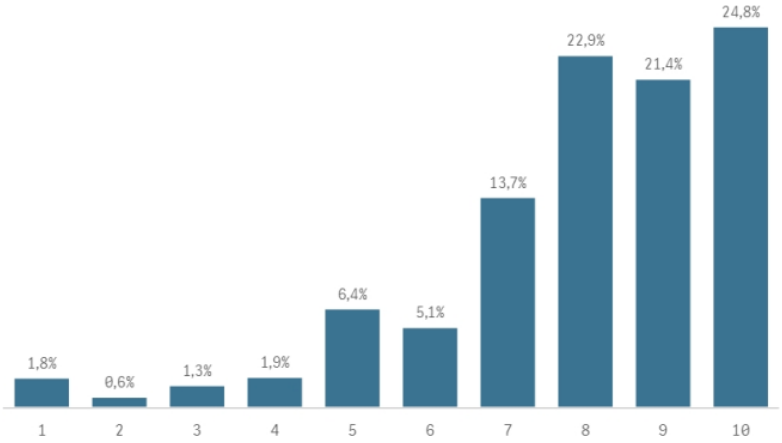

Figure 3: Percentage frequency distribution.

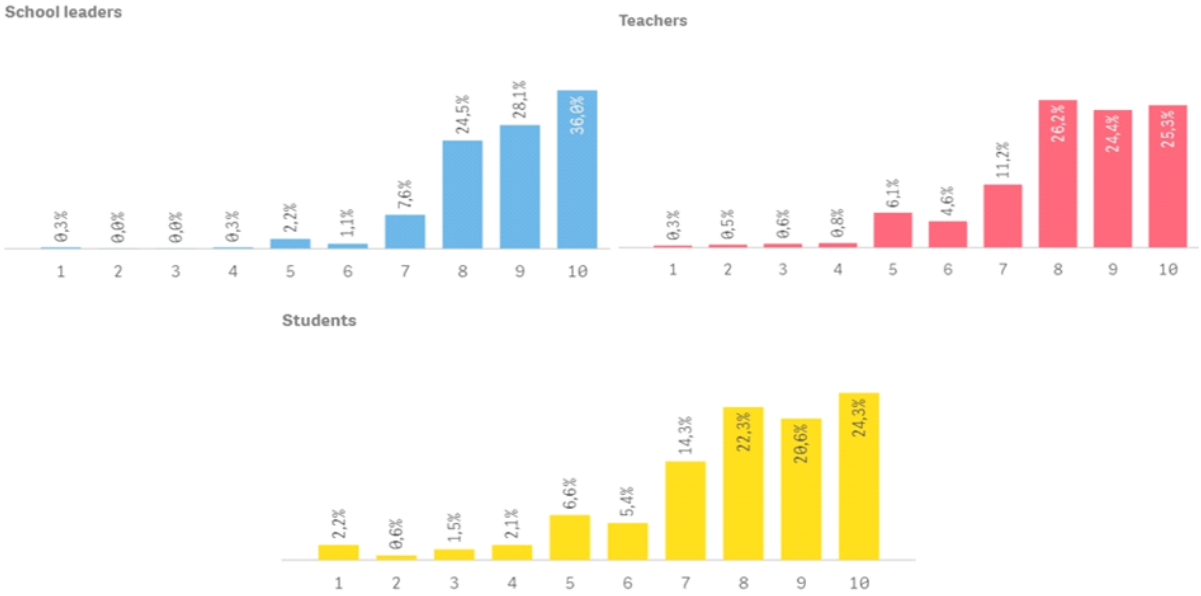

Figure 4: Percentage frequency distribution by user profile.

tions, which are 7.96 and 7.95 accordingly.

For now, educational institutions need to learn the results gotten, create a plan for fixing the existing flaws, and, as the next step, design a strategy of development for digital technologies.

The Ministry of Education and Science of Ukraine plans that from the beginning of a new academic year there will be preparation for a broad implementation of SELFIE (JRC et al., 2021) in all the systems of secondary and professional education.

4 CONCLUSIONS

Summarising foreign and domestic experiences analysis of scientific and methodical sources, methods, ways and tools of digital transformation of secondary education and organization of self-assessment of all the participants of educational process on the questions of implementation of digital technologies in Frameworks of designing educational policy, defining the ways of designing digital educational environment of a secondary educational institution, the results of the conducted survey let us make the following conclusions.

1. The modern educational system in Ukraine, and the educational process of every specific institution needs digital transformation, which can ensure the quality and efficiency of the educational process. For the sake of it, it is appropriate to foresee and project educational policy, which will include aspects of digitalization and development of

digital educational environment. Necessary and sufficient conditions for its effective usage is a high level of digital competency of all stakeholders of the educational process. Thanks to the fast development of digital technologies and modern techno trends systematic approach to digital transformation imply complex interaction of all participants in the educational process. For avoiding resistance to the usage of digital technologies it's important to delineate the advantages of digital transformation in education and popularise it on the governmental level as well as locally. Understanding and using educational digitalization are the key to success, that's why prioritizing this is important. Highlighting contribution to the development of digital community among teachers and students, having made its a base of the educational policy of an educational institution, it is possible to create quality and effective educational space for the new generation. In its turn, it will help an educational institution to stay actual, suggesting to educational applicants a modern level of learning. The level which is needed for further success in life. Projecting, designing, developing, and using a modern digital educational environment is the right way for the digital maturity of all its participants.

2. Realization of this model of digital educational environment requires creating a team of like-minded people, defining the main goals and tasks, technologies, methodologies, and innovations needed for their achievement. An important stage of the digital educational environment will be the stage of defining and further shaping of levels of digital competency of all the participants in the educational process: students, teachers, educational managers of different levels, parents as citizens of digital society, employers as citizens of digital society and business-communities.
3. Monitoring the level of digital skills and digital readiness of all the participants in the educational process is an integral part of the algorithm for designing and implementing digital policy in a secondary educational institution, and that is why every educational institution should be required to have demands for the digital competency level of all participants and ensure it with the help of arranging special seminars and training for advanced training and learning. Choice of the tool, which will allow an educational institution to arrange self-reflection and self-assessment correctly and will help estimate the level of readiness for the digitalising the educational environment, plays an important role. The SELFIE tool helps educational institutions to analyse and estimate the current state of digital competency, and to develop educational programs and processes in the future. Renewing the content of learning, improving the digital competency of all participants in the educational process, the newest pedagogical technologies, and modern logistical equipment are the factors which form the quality of given educational services.

REFERENCES

Barna, O. V. and Kuzminska, O. H. (2020). Vyznachennia hotovnosti zakladu vyshchoi osvity do tsyfrovoi transformatsii [Determining the readiness of a higher education institution for digital transformation]. In *Suchasni informatsiini tekhnolohii ta innovatsiini metodyky navchannia: dosvid, tendentsii, perspektyvy: materialy IV Mizhnarodnoi naukovo-praktychnoi internet-konferentsii*, page 92–93, Ternopil. TNPU im. V. Hnatiuka. http://dspace.tnpu.edu.ua/bitstream/123456789/15374/1/31_Barna_Kuzminska.pdf.

Berawi, M. A., Suwartha, N., Asvial, M., Harwahyu, R., Suryanegara, M., Setiawan, E. A., Surjandari, I., Zagloel, T. Y. M., and Maknun, I. J. (2020). Digital Innovation: Creating Competitive Advantages. *International Journal of Technology*, 11(6):1076–1080. https://doi.org/10.14716/ijtech.v11i6.4581.

Cabinet of Ministers of Ukraine (2021). On the approval of the Concept of the development of digital competences and the approval of the plan of measures for its implementation. https://tinyurl.com/mry8pyaw.

Carretero, S., Vuorikari, R., and Punie, Y. (2017). *DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use*. Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/38842.

Elkin, O., Hrynevych, L., kalashnikova, S., Khobzey, P., Kobernyk, I., Kovtunets, V., Makarenko, O., Malakhova, O., Nanayeva, T., Shiyan, R., and Usatenko, H. (2017). *The New Ukrainian School: conceptual principles of secondry school reform*. https://mon.gov.ua/storage/app/media/zagalna%20seredn ya/Book-ENG.pdf.

European Commission, Joint Research Centre, Redecker, C., and Punie, Y. (2017). *European Framework for the Digital Competence of Educators: DigCompEdu*. Publications Office of the European Union, Luxembourg. https://doi.org/10.2760/159770.

Gavrilova, L. G. and Voronova, N. S. (2018). Digital culture as a phenomenon of modern informational and communication pedagogical environment. *Zasobi navčal'noj ta naukovo-doslìdnoï roboti*, (48):21–34. http://journals.hnpu.edu.ua/index.php/sciencemeans/article/view/688.

Gillpatrick, T. (2020). Innovation and the Digital Transformation of Education. *The Journal of Limitless Educa-*

tion and Research, 5(3):194 – 201. https://doi.org/10.29250/sead.797372.

Hardy, I., Heikkinen, H., Pennanen, M., Salo, P., and Kilakoski, T. (2021). The 'spirit of the times': Fast policy for educational reform in Finland. *Policy Futures in Education*, 19(7):770–791. https://doi.org/10.1177/1478210320971530.

Intel (2019). Transforming Education for the Next Generation: A Practical Guide to Learning and Teaching with Technology. https://www.intel.com/content/www/us/en/education/solutions/transforming-education-next-generation-guide.html.

JRC, ETF, Bocconi, S., Lightfoot, M., Brolpito, A., Giannoutsou, N., Hippe, R., and Kampylis, P. (2021). Scaling up and integrating the SELFIE tool for schools' digital capacity in education and training systems: Methodology and lessons learnt. Joint report TA-02-21-335-EN-N (online), Joint Research Centre (JRC, B.4) of the European Commission, and the European Training Foundation (ETF), Turin. https://www.etf.europa.eu/en/publications-and-resources/publications/scaling-and-integrating-selfie-tool-schools-digital.

Karim, S. (2021). Acculturation in a globalised world: Implications for theory and educational policy and practice. *International Journal of Comparative Education and Development*, 23(1):44–58. https://doi.org/10.1108/IJCED-11-2020-0078.

Kulesz, O. (2017). *Culture in the Digital Environment: Assessing impact in Latin America and Spain*. United Nations Educational, Scientific and Cultural Organization, Paris.

Kuzminska, O. H. and Nanaieva, T. V. (2016). Education policy and information technologies: How to achieve a systemic effect? *INFORMATION TECHNOLOGIES AND LEARNING TOOLS*, 52(2):121–132. https://doi.org/10.33407/itlt.v52i2.1376.

Ministry of Digital Transformation of Ukraine (2019). Digital literacy of the population of Ukraine. https://osvita.diia.gov.ua/uploads/0/588-the_first_in_the_history_of_ukraine_research_compressed.pdf.

Ministry of Digital Transformation of Ukraine (2021a). Conceptual-referential framework of digital competence of pedagogical and scientific-pedagogical workers: draft. https://osvita.diia.gov.ua/uploads/0/2629-frame_pedagogical.pdf.

Ministry of Digital Transformation of Ukraine (2021b). DigCompUA for Citizens 2.1. https://cutt.ly/iLimwNz.

Ministry of Digital Transformation of Ukraine (2021c). Digital literacy of the population of Ukraine: Report on the Results of the National Survey. https://osvita.diia.gov.ua/uploads/0/2623-research_eng_2021.pdf.

Ministry of Digital Transformation of Ukraine (2023). Digigram. https://osvita.diia.gov.ua/en/digigram.

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.

Sych, T., Khrykov, Y., and Ptakhina, O. (2021). Digital transformation as the main condition for the development of modern higher education. *Educational Technology Quarterly*, 2021(2):293–309. https://doi.org/10.55056/etq.27.

Verkhovna Rada of Ukraine (2020). Law "About Full General Secondary Education". https://zakon.rada.gov.ua/laws/show/463-20#Text.

Zawacki-Richter, O. and Anderson, T., editors (2014). *Online Distance Education: Towards a Research Agenda*. Issues in Distance Education. Athabasca University Press. https://doi.org/10.15215/aupress/9781927356623.01.