FUTURITY
Education

DOI: https://doi.org/10.57125/FED.2022.25.12.06

How to cite: Li, T., & Zalialetdzinau, K. (2022). Attemps of scientific reflection on the role of e-learning of the future in the area of digital transformation: new opportunities and experiences with DevSecOps. *Futurity Education, 2*(4), 63–76. https://doi.org/10.57125/FED.2022.25.12.06

Attempts of Scientific Reflection on the Role of e-Learning of the Future in the Area of Digital Transformation: New Opportunities and Experiences with DevSecOps

Tchon Li*

PhD, Associate Professor, Head of International Business & Marketing Department International Business & Marketing Department, Yanka Kupala State University of Grodno, Grodno, Belarus, https://orcid.org/0000-0002-6452-1038

Kanstantsin Zalialetdzinau

software engineer Brimit LLC, Republic of Belarus, Minsk, https://orcid.org/0000-0003-1938-0122

***Correspondence email:** *kaf_komde@grsu.by.*

Received: October 9, 2022 | **Accepted**: December 1, 2022 | **Published:** December 25, 2022

Abstract. The introduction of such an important component as e-learning into the education system is an important tool for the informatization of education problem implementation and requires certain knowledge. It is also necessary to form the conditions for mastering the latest pedagogical approaches and methods that have acquired new forms or appeared under the influence of the introduction of information technologies into educational activities. The use of the latest technologies in educational activities is one of the key, as it increases the opportunities for the development of

creative potential and helps in mastering professional knowledge, which is based on the awareness of one's own educational and developmental goals. The purpose of the research is to analyze the specific features of e- learning development in the period of digital transformation and to figure out the new opportunities of DecSecOps. The main methods used in the work were: comparative method, method of abstraction, deductive method, concretization. The results states that the formation of electronic education in Belarus is connected with the opportunities provided by information and communication technologies, and falls on the first decade of the XXI century, when the understanding and implementation of this educational practice at the institutional and regulatory levels begins. Belarus is gradually joining the system of distance education, is involved in cooperation with international open universities on the introduction of e-learning, and is also forming its own educational electronic environment. The conclusion is oriented on the realization that in the time of digitalization and technological transformation, in the countries worldwide can be noted the tendency in the development of DevSecOps.

Keywords: digitalization, digital transformation, e-learning, Belarus, changes, attempts, experience, DevSecOps.

Introduction

Education in the modern stage of societal development is faced with a dilemma: to adhere to the traditional format, which has been demanded and effective for centuries, or to incorporate innovative models into its arsenal, emphasizing variability and the uncertainty of outcomes. Currently, it can be confidently stated that the choice in the educational sphere has been made in favor of innovations in the educational form cluster while fully preserving the content and purpose of education.

These realities have become a prerequisite for invigorating scientific research on the analysis of innovative dimensions in modern education. One of the important and relevant topics in this context is the exploration of digital learning.

Considering that digital learning is a relatively new format of educational activity, modern scientific literature extensively describes various aspects of this innovative model (see Table 1).

Table 1

Analysis of Digital Learning in Contemporary Scientific and Pedagogical Discourse

Development of critical thinking during digital learning (Chou et al., 2019)
Overall strategy of teaching digitization (Mohamed Hashim et al., 2022)
Perception of blended learning by participants in the educational process (Dakduk et al., 2018)
Innovative technologies in education (Ellis & Bliuc, 2019)
Game cluster of digital learning (Fox et al., 2018)
Institutional and normative basis of e-learning (García-Peñalvo, 2021)
Electronic learning management systems (Koh & Pei Kan, 2021)

Perception of learning management system during the COVID-19 pandemic (Raza et al., 2021)
M-Learning as an element of digital learning (Razzaque, 2020)
Development of digital skills in education (Sousa & Rocha, 2019)
Development and prosperity thinking in digital education (Tan, 2017)
Challenges of integrating technologies into the educational sphere (Wieser, 2020)
Digital learning as a factor in improving performance (Zhong & Li, 2020)

Source: Compiled by the authors based on sources from bibliographic databases: Sagejournals, Taylor & Francis.

Research Problem

The latest technologies provide new opportunities for solving the problem of informatization of education. It is these technologies that act as an "amplifier" of intelligence and open other dimensions of consciousness, connecting them into a single whole and creating a certain system of knowledge of a new level. The use of the latest technologies serves as a necessary means of achieving the level of quality education, strengthens creative possibilities and effectively affects the personal perception of the surrounding world. The multifaceted use of information technologies in education is rapidly and constantly growing. To prepare theoretically at a high level, to teach how to choose a strategy and options for acquiring knowledge, to form active and personalized learning strategies - all this will significantly increase the effectiveness of teaching and acquisition of knowledge by those who study. The relevance of the use of e- learning in the education system is due to the need to effectively and at the appropriate level ensure the implementation of the main tasks set before education, increase personal, general cultural and communicative qualities. Unfortunately, it must be stated that there are still many factors and problems inhibiting the wide introduction of information technologies in education, one of which is the incomplete awareness of the importance of these innovations by some specialists.

Research Focus

Education is a means of socialization and personality formation, a kind of catalyst that supports the balance of society from the inside. Education consists in the formation of stable value orientations in a person, based on a broad base of knowledge and confidence in one's capabilities, which are manifested in mastering the competencies necessary for life in society. The stability of society is directly dependent on the stability of its educational systems, the conformity of education itself with modernity, that is, on what we teach a growing person and to whom we offer the content of education. In our country, information technologies have been introduced into education for almost half a century. The first steps are the use of educational computing complexes such as DVK, UKNC, Search, Yamaha, ZX Spectrum, Agat and others, mostly in computer science classes. The second important step on the way to the introduction of information technologies in education is the wide use of multimedia capabilities of computer technology. And the third step consists in the wide use of Internet resources both in the classroom and outside the classroom educational activities. Over time, the use of Internet resources is becoming increasingly popular and it is being implemented and used also during homework. It should

be emphasized that the mentioned applications of information technologies in education are the first steps of informatization of education.

Research Aim and Research Questions

Informatization of education is a set of interconnected organizational-legal, socio-economic, educational-methodical, scientific-technical, production and management processes aimed at meeting information, computing and telecommunication needs (other needs related to the implementation of methods and tools information and communication technologies - ICT) of participants in the educational process, as well as those who manage and ensure this process (including its scientific and methodological support and development), and are also the basis of informatization of society, which in recent times is extremely relevant for our country UNESCO experts believe that in order to match the qualifications of workers to the level of the information society, it is necessary to introduce electronic learning into the educational process, which orients students to a new style of education and promotes the development of their abilities and skills for further learning throughout life.

Research Methodology

The theoretical and methodological basis of the study of the importance of e-learning in the period of modern digital transformation, the specific features of Belarus informative transformation, the fundamental provisions of modern theory based on new experience of DevSecOps, the work of leading Belarus and foreign scientists and practitioners in the field of digitalization, new opportunities of DevSecOps, the digitalization of the society have become very popular in the period of transformation of the post-industrial society. In the research process, general scientific research methods were used, namely: system analysis, synthesis, deduction and induction, typology, historical-logical, institutional analysis, structural-functional analysis.

Research Results

Electronic learning (e-learning) is a form of learning using a computer curriculum. It covers computer-based training, electronic enforcement systems (EPS), distance learning and online learning. The educational process in e-learning is conducted on the basis of electronic training courses. E-learning is playing an increasingly important role in the training of organizational personnel. Yes, in the USA, almost 90% of companies implemented e-learning. In Belarus, the greatest activity regarding the introduction of electronic training of employees is observed in banks and insurance companies. For example, PrivatBank introduced a distance learning system back in 2001. E-learning is most in demand where there is a need to train a large number of employees in similar competencies. It is provided through websites and intranets; CD-ROMs are also widely used. Training is possible in the form of online coaching and discussion forums. Content can be presented using PowerPoint, video and audio clips, "drag questions", PDF files, links to websites and communities of learners. E-learning contributes to the formation of a single corporate center of knowledge. Thanks to this form of personnel training, social groups of employees are formed according to professional needs and interests, and this is one of the components of the organization's knowledge management technology, which involves searching for information, forming a knowledge base, sharing and using it (Bykov et al., 2020).

The following types of e-learning are distinguished:

• e-learning at an individual pace, when the employee uses technology, but at the same time is not connected to the teacher or other students;

• e-learning, during which an employee, using technology, interacts with a teacher who is in another place;

• e-learning thanks to the exchange of information and knowledge takes place in the form of discussion forums, practical communities, bulletin boards and chats.

The introduction of e-learning requires large funds from the organization. According to expert estimates, the implementation of an average project can cost about $500,000. Therefore, e-learning is easier to implement for large companies than for medium and small ones. In order to reduce the costs of introducing e-learning, small enterprises can use the services of external providers that offer e-learning systems for rent, outsourcing of educational process support, etc. The cost of the project, in particular, includes the costs of setting up and adapting the product, purchasing licenses for users, and developing electronic training courses. Personnel costs are also significant, since the development of high-quality electronic courses involves the involvement of a team of professionals: programmers, artists, animators, pedagogical designers, etc. Under such conditions, for the purpose of economical use of funds, it is important for the enterprise to weigh for itself both the advantages and disadvantages of the introduction of electronic training of personnel. At the same time, e-learning should be optimally combined with other forms of employee training.

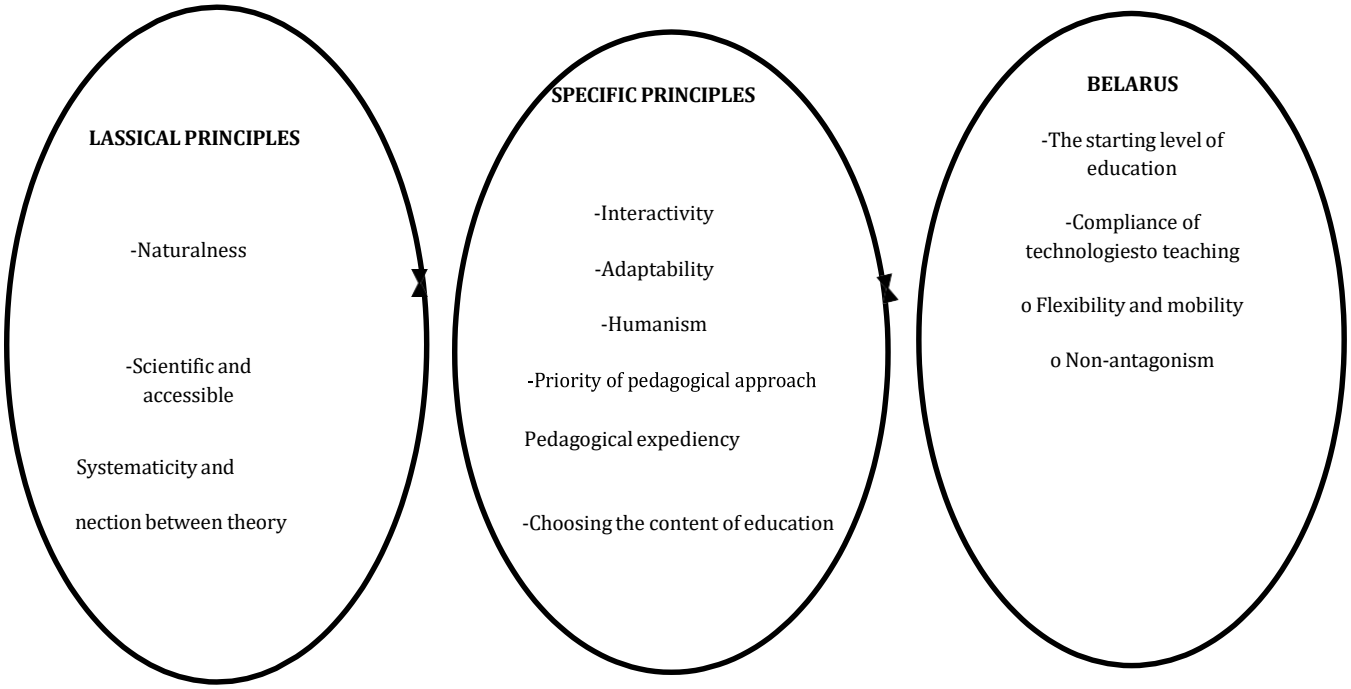
The advantages of e-training for personnel include: preservation of working hours of employees who do not leave their workplaces, while simultaneously ensuring high quality of education; reduction of the organization's expenses for teachers and trainers; the possibility of simultaneous training of a large number of employees of the company's divisions and branches located in different regions; reduction of expenses for students' and trainees' trips to educational institutions and per diems for renting residential premises; use of e-learning as an element of personnel certification in order to determine the compliance of the employee's competence level with corporate requirements; the use of interactive technologies reduces learning time by an average of 50%; work stability (a computer, unlike people, does not have bad or good days), mastery of learning (if a student does not cope with one task, he cannot move on to another) (Kremen, 2020).

Certain disadvantages of e-training of personnel include: it is difficult to form practical skills in the learning process, since there is no live contact with the teacher; it is difficult for an employee at the workplace to plan and find the necessary time for training during working hours; there is no direct communication with the same employees from other organizations (similar problems, ways to overcome them, finding optimal approaches to various tasks); the speed of implementation of achievements of scientific and technical progress is ahead of the speed of development of e-learning courses, while the teacher is a direct carrier of new knowledge and changes.

During the analyses of the classical principles, it is possible to underline the classical and specific principles of e-learning and those that are widespread in Belarus, that are presented in figure 1.

Figure 1

Classical, Specific Principles of e-Learning and Principles of e-Learning of Belarus



Source: created by authors.

Analyzing the specific features of e-learning in Belarus it is important to mention, that nowadays there are couples of types, the main of which are:

Online learning is a classic type of learning that uses an approach called face-to-face. With this approach, the teacher independently decides in each specific case whether it is necessary to combine regular (classical) training with online training. The advantage of this type of education is an individual approach to each student and the opportunity to work at an individual pace for each student.

Blended learning can be an effective option for obtaining an education. This approach combines offline (classical) learning with online learning.

Blended learning is a curriculum in which a student learns at least partially through online access to content and instructions and with some element of student control regardless of time, place, sequence of presentation, or pace. This is a combination of classical classroom learning with computer-mediated activities.

Studies show the effectiveness of such training in comparison with non-networked (non-hybrid) traditional counterparts. This may be partly due to the fact that this fast-paced learning model not only increases the flexibility and individualization of student learning, but also allows teachers to expand their opportunities as facilitators of learning (Pinchuk, 2018).

Differences between e-learning and Internet learning in the period from 2010 to 2021 in Belarus are presented in table 1.

Table 1

Differences Between e-Learning and Internet Learning in the Period from 2010 to 2021 in Belarus

The characteristic of e-learning in 2021	The characteristic of e-learning in 2010
Distributed consolidated knowledge	Generation of new knowledge
Generation of new knowledge	Still having an e-teacher
Self-study	Isolation of the student
Creation of learning communities	Distribution through single providers/institutions
It is a result and a tool for supporting partners	Ignores student messages and previous achievements
Combines the student's message and previous achievements	It suppresses the student's creative approach
Stimulates a creative approach by increasing spontaneous and/or playful approaches to learning	Shrinks the role of teachers and learning mediators
Focuses on technology and content	Narrows the role of teachers and learning mediators)
Focuses on quality, process and educational content (context)	Replaces audiences. Integrates into organizational and social processes
Enriches and motivates those who don't know yet	Privileges those who already know

Source: created by authors.

As in the case of DevOps, team work is no less important to a DevSecOps engineer, and the ability to resolve conflicts will be very helpful in creating the most secure software applications. Thus, it can be said that from the very beginning of the life cycle of a software application, DevSecOps deals with its security, ensuring the creation of various means of protection.

Today, organizations face cybersecurity threats that are becoming increasingly diverse, complex, and sophisticated. At the same time, not every company has a department of cyber security specialists. But any modern IT company should think about the security of its products. The solution may be tools for automating security processes, in order to deploy security solutions faster and not have to maintain a large cybersecurity department. In practice, the main reasons for the appearance of security breaches are deficiencies in the implementation of protection mechanisms, vulnerabilities in the application code, and configuration deficiencies (Ferrari, 2021). Very often, control by the information security service is carried out at the last stages of the application life cycle. Such a scenario is incompatible with modern

DevOps and Agile methods, which reduce software delivery cycle times to several weeks. Specialists highlight the following in order to stimulate the main points:

1.Collective responsibility. Each employee of the company has his share of responsibility for information security, thereby realizing his contribution to ensuring this same security.

2.Cooperation and integration. Is it possible to achieve success in information security by confrontation? The question is rhetorical, so cooperation is only cooperation.

3.Pragmatics in implementation. For a pragmatic approach, such a model of digital security should be used, which will be independent of the infrastructure. Also, this model should immediately focus on the

development of software applications, ensuring security, confidentiality and trust in the digital environment.

4.Support for development standards. Sometimes it is not easy to fill the gaps between development and standards. The key to this will be the transformation of management tools into appropriate software criteria. Also, we must not forget about the turning points in the software life cycle - it is here that the above- mentioned control tools can be measured and automated.

5.Automation. How to improve software quality? With the help of regular, thorough and timely testing. It is important to automate processes that are amenable to automation, and it is desirable to abandon those that are not amenable to automation.

6.Measurement+monitoring+reporting+action. For the implementation of DevSecOps to be successful, software development must be constantly monitored by responsible persons. The main Usually, DevOps engineers (table 2) come from system administrators who are no longer interested in their profession or who are dissatisfied with the salary. Admin experience usually covers the Ops part, so you only need to cover the basic Dev part to get started. As a DevOps engineer, you are faced with a large number of different tasks that are often dissimilar. Thanks to this, this profession remains interesting even after many years (Calvani et al., 2019).

Table 2

The Advantages and Disadvantages of DevOps Engineers

Advantages of DevOps engineers	Disadvantages of DevOps engineers
The demand for such specialists. DevOps engineers are flying like hotcakes right now. Yes, the demand has always been high, but due to the lack of qualified personnel, clients make concessions and are ready to offer attractive conditions for an engineer	Incomplete projects that only cover one or two aspects of DevOps. For example, CI (the code build and test process) and its release, where the engineer is only responsible for delivering the build results and verifying that everything was successful. Or an Infrastructure Engineer who is only involved in setting up servers and environments and does not work directly with developers or customers.

Close cooperation between teams of developers, testers and other participants in the development of a software product. This gives an opportunity to delve deeper into the project and, as a result, speed up its entry into the market.	There are often positions like a DevOps engineer, but in reality it is support of an already finished product or finishing and fixing bugs for someone. This often happens when a company has developed a product with its own engineers, and less important functionality is outsourced to countries with lower labor costs to save money.
Long-term relevance of the profession. Despite the rapid development of technologies, the principles of work cannot change radically in one or even five years. Servers and Linux are not going anywhere and will still be relevant ten years from now.	In the case of incorrect work realization, a negative factor can be obtained - the costs associated with the implementation of the system can slow down the internal work of the entire company. Not every department can clearly understand the goal set before it, which will slow down the work of the entire chain.
Knowledge of programming languages is not required. Yes, you will still have to familiarize yourself with the base, but it will come gradually. Accordingly, it makes it easier to transition from system administration or even from another profession to DevOps.	Based on the accumulated problems of softwa development. A key flaw was seen in t interactions between the development an operation teams, which could slow down t product development process. Then DevO engineers began to appear, occupying a nic between managers and developers, in order configure and automate the infrastructure for t applications that developers work on.

Source: created by authors.

In many countries all over the world, in the period of digitalization that Belarus is facing also, it is very important to mention the new opportunities and experiences with DevSecOps. Advantages of DevSecOps can be characterized as the following:

1.DevSecOps integrates applications and infrastructure security tasks into Agile and DevOps processes and tools. As with Agile tools, DevSecOps includes versatile, synergistic methods such as continuous integration and continuous delivery (hereafter CI/CD) that encourage and support frequent code reviews, version control, intelligent test automation, continuous releases with low risk level and feedback. In a DevSecOps environment, a business can benefit from such practices by saving resources through improved operations, reduced rework, improved quality through automated testing and monitoring, and faster delivery of projects/products to the client.

2.Solves security problems as they arise, when it can be done with less time and money. This approach allows checking, auditing, scanning and testing code for security at each stage of the development cycle. Security problems are eliminated immediately after they are detected. This excludes the appearance of additional dependencies and increases the speed of correction of detected security vulnerabilities. Development speed, security, and code quality increase, while costs decrease.

3.It allows sharing the responsibility for the security of applications and infrastructure between specialists in the development, security and operation of IT systems. Closes such questions as: - who is

looking for vulnerabilities; – who fixes vulnerabilities; - who verifies the correctness and completeness of the correction; - how to ensure cooperation between departments. The DevSecOps approach ensures that members of the operations and security team are involved in development from the very beginning. An important role in DevSecOps is played by the distribution of security responsibilities among product and process owners. Thus, engineers and developers become owners of processes and bear responsibility for their work.

4.Integration with CI/CD conveyors. It is possible to integrate cyber security testing into sets of automatic tests. Modern programs for the automatic search for vulnerabilities allow you to analyze the source code directly through CI/CD pipelines, such as Jenkins or TeamCity, and based on the results of the work, create tickets with the task of fixing the vulnerability. In automatic tests, you can set the necessary scanning parameters for a specific project, thus taking into account the specifics and features of each product, depending on its purpose. For example, if the application uses third-party libraries, third-party component analysis (SCA) can be enabled to detect vulnerabilities in third-party code. Automation allows you to make sure that the product has successfully passed the stage of modular security testing. In addition, it is possible to test the source code by the method of static analysis at the development stage and dynamic analysis of applications at the testing stage before deploying the final update in the working environment (Cartelli, 2020).

Discussion

In the last ten years, in the world and in Belarus in particular, there has been an intensification of the introduction of technologies and practices of electronic education. Such transformations had a number of prerequisites: the rapid development of information and communication technologies, a revolutionary increase in Internet coverage and a significant simplification of access to it, the emergence of new web communication technologies, in particular social networks and mobile applications, the distribution of open software products to provide electronic (distance) learning, its organization and control.

Such rapid development also affected the development of electronic education in Belarus higher educational institutions. In particular, the principles underlying the normative regulation of e-learning in Belarus higher education institutions were revised: in the Regulation on distance learning, adopted by the Ministry of Education of Belarus in 2019, instead of centralization and a hierarchical model of the organization of the e-education system with the separation of central and supporting regional centers, the idea was formed an open system of e-learning organization in the system of higher education of Belarus, based on the initiatives and capabilities of Belarus higher education institutions, provided that the specified criteria are met. In view of this, in 2019 the Ministry of Education of Belarus approves the requirements for universities and institutions of postgraduate education, scientific, educational and scientific institutions that provide educational services in the distance form of training for the training and advanced training of specialists in accredited areas and specialties (Malytska, 2020).

Analyzing the e-learning of the future in the era of the digital transformation in Belarus, it is necessary to mention the following specific features:

1) the availability and content of the educational content presented on the website (schedule of classes; work programs of disciplines; lecture material (electronic texts, graphics, drawings, tables, tests for all types of knowledge level control, current and final control); practical tasks

with methodical recommendations for their implementation; video and audio recordings of lectures, seminars and practical works; glossary of educational material terms; bibliography; laboratory works with methodical recommendations for their implementation, etc.);

2) the use of remote interaction technologies in the educational process (for example, the systematic use of e-mail addresses or teacher accounts in social networks, separate distance education platforms (for example, Moodle), the presence of servers with a 24-hour access mode for creating, storing

and transferring data necessary for remote training and management of the educational process, software for authorized access of distance learning subjects to these web resources, etc.);

3) use of information storage servers (availability of special resources and platforms for systematic content collection: electronic card libraries, repositories, electronic catalogs, electronic servers of periodicals, educational and informational portals, etc.);

4) the application of educational platforms of electronic education (fragmentary - distance platforms by higher educational institutions in the role of auxiliary servers accompanying full-time and correspondence forms of education; systemic - distance platforms in the role of an autonomous electronic educational space for the organization of the distance learning process);

5) coverage and inclusion of the educational process in the Internet environment (the educational process is fully integrated in the Internet environment - all necessary courses are available in the electronic version, educational materials provided for by curricula and programs, all faculties and structural units engaged in professional training are presented and the organization of the educational process or the fragmented inclusion of the educational process in the web environment - only individual courses, educational and methodological materials, directions of training or structural divisions, in particular, institutes and centers of postgraduate education and advanced training are presented);

6) regulation and institutionalization of the educational process in the web environment (the presence of a separate Regulation on distance learning in the educational institution, approved by the Academic Council or a section in the Regulation on the organization of the educational process, the functioning of a division (institute, center, department) of distance (electronic) learning with the corresponding personnel and logistical support that organizationally and technologically supports distance education, the availability of methodological recommendations for the development and use of distance education technologies in the educational process, etc.).

Conclusions and Implications

In the last ten years, in the world and in Belarus in particular, there has been an intensification of the introduction of technologies and practices of electronic education. Such transformations had a number of prerequisites: the rapid development of information and communication technologies, a revolutionary increase in Internet coverage and a significant simplification of access to it, the emergence of new web communication technologies, in particular social networks and mobile applications, the distribution of open software products to provide electronic (distance) learning , its organization and control (OECD, 2020).

Such rapid development also affected the development of electronic education in Belarus higher educational institutions. In particular, the principles underlying the normative regulation of e-learning in Be higher education institutions were revised: in the Regulation on distance learning, adopted by the Ministry of Education of Belarus in 2019, instead of centralization and a hierarchical model of the organization of the e-education system with the separation of central and supporting regional centers, the idea was formed an open system of e-learning organization in the system of higher education of Belarus, based on the initiatives and capabilities of Belarus higher education institutions, provided that the specified criteria are met. In view of this, in 2019 the Ministry of Education of Belarus approves the requirements for universities and institutions of postgraduate education, scientific, educational and scientific institutions that provide educational services in the distance form of training for the training and advanced training of specialists in accredited areas and specialties. The advantages of training conducted using e-learning technologies include:

1.Personification. The listener of training conducted using electronic learning technologies can independently: determine the speed of studying the educational material; determine when he wants to study; determine exactly which sections of the educational material and in what sequence it needs to be studied.

2.The possibility of training without separation from production.

3.The possibility of combining educational content to form various educational programs adapted to a specific student.

4.An opportunity to obtain much more information necessary for the assessment of knowledge, skills and abilities obtained as a result of the training. Including: time spent on questions, number of attempts, questions or tasks that caused the most difficulties, etc. The availability of such information allows for much more flexible management of training.

5.Cost. Despite the need for high initial investments, training conducted using e-learning technologies turns out to be significantly cheaper compared to traditional face-to-face training.

6.Use of a wide range of different teaching aids. All these funds can be used during traditional face-to-face training, but most often this does not happen, and electronic training requires their mandatory use. As a result of this training, which is conducted using electronic learning technologies, it is often more effective compared to traditional face-to-face training.

7.The possibility of its use for the training of persons with limited capabilities.

8.Providing access to quality education to persons who, for one reason or another, do not have the opportunity to study in traditional face-to-face form. For example, there is no high-quality educational institution in their place of residence.

9.Construction of an effective training management system based on the ability to collect much more information about the student's training compared to traditional face-to-face training.

Disadvantages of training conducted using e-learning technologies include:

1.The difficulty of making operational changes, if training has already begun.

2.The need to form additional motivation among students of training conducted using electronic learning technologies, compared to other forms of training.

3.The need for high investments when building an e-learning environment.

4.High dependence on technical infrastructure. A failure in the infrastructure can lead to a decrease in efficiency or a complete disruption of training.

5.Lack of a sufficient number of specialists in the field of electronic learning technologies.

6.High investment in making changes to educational content.

References

Bykov, V., Mikulowski, D., Moravcik, O., Svetsky, S., & Shyshkina, M. (2020). The use of the cloud-based open learning and research platform for collaboration in virtual teams*. Information Technologies and Learning Tools, 76*(2), 304–320. https://doi.org/10.33407/itlt.v76i2.3706

Calvani, A., Fini, A., & Ranieri, M. (2009). Assessing digital competence in secondary education. Issues, models and instruments. In M. Leaning (Ed.), *Issues in Information and Media Literacy: Education, Practice, and Pedagogy* (pp. 153–172). Informing Science Press.

Cartelli, A. (2020). *Current trends and future practices for digital literacy and competence*. IGI Global.

Chou, T.-L., Wu, J.-J., & Tsai, C.-C. (2019). Research trends and features of critical thinking studies in e-learning environments: A review. *Journal of Educational Computing Research, 57*(4), 1038–1077. https://doi.org/10.1177/0735633118774350

Dakduk, S., Santalla-Banderali, Z., & van der Woude, D. (2018). Acceptance of blended learning in executive education. *SAGE Open, 8*(3). https://doi.org/10.1177/2158244018800647

Ellis, R. A., & Bliuc, A.-M. (2019). Exploring new elements of the student approaches to learning framework: The role of online learning technologies in student learning. *Active Learning in Higher Education, 20*(1), 11–24. https://doi.org/10.1177/1469787417721384

Ferrari, A. (2021). *Digital competence in practice: An analysis of frameworks*. Publications Office of the European Union. https://publications.jrc.ec.europa.eu/repository/handle/JRC68116

Fox, J., Pittaway, L., & Uzuegbunam, I. (2018). Simulations in entrepreneurship education: serious games and learning through play. *Entrepreneurship Education and Pedagogy, 1*(1), 61–89. https://doi.org/10.1177/2515127417737285

García-Peñalvo, F. J. (2021). Avoiding the dark side of digital transformation in teaching. An institutional reference framework for elearning in higher education. *Sustainability, 13*(4), Article 2023. https://doi.org/10.3390/su13042023

Koh, J. H. L., & Pei Kan, R. Y. (2021). Students' use of learning management systems and desired e-learning experiences: are they ready for next generation digital learning environments?. *Higher Education Research & Development, 40*(5), 995–1010. https://doi.org/10.1080/07294360.2020.1799949

Kremen, V. (2019). Categories "space" and "environment": Peculiarities of model presentation and educational application. *Theory and Practice of Social Systems Management*, (2), 3–16. https://aait.op.edu.ua/?fetch=articles&with=info&id=43

Malytska, I. D. (2015). Assessment of pupils' IT-competence in Great Britain schools. *Information Technologies and Learning Tools, 49*(5), 89–105. https://doi.org/10.33407/itlt.v49i5.1297

Mohamed Hashim, M., Tlemsani, I., & Matthews, R. (2022). Higher education strategy in digital transformation. *Education and Information Technologies, 27*, 3171–3195. https://doi.org/10.1007/s10639-021-10739-1

OECD. (2020). *Students, computers and learning: Making the connection*. OECD Publishing. https://doi.org/10.1787/9789264239555-en

Pinchuk, O. P. (2016). Perspective analysis of use of social networks as learning tools in learning environment. *Information Technologies and Learning Tools, 54*(4), 83–98. https://doi.org/10.33407/itlt.v54i4.1482

Raza, S. A., Qazi, W., Khan, K. A., & Salam, J. (2021). Social isolation and acceptance of the learning management system (LMS) in the time of COVID-19 pandemic: An expansion of the UTAUT model. *Journal of Educational Computing Research, 59*(2), 183–208. https://doi.org/10.1177/0735633120960421

Razzaque, A. (2020). M-learning improves knowledge sharing over e-Learning platforms to build higher education students' social sapital. *SAGE Open, 10*(2). https://doi.org/10.1177/2158244020926575

Sousa, M. J., & Rocha, A. (2019). Digital learning: Developing skills for digital transformation of organizations. *Future Generation Computer Systems, 91*, 327–334. https://doi.org/10.1016/j.future.2018.08.048

Tan, O. S. (2017). Technology, future learning and flourishing thinking. *International Journal of Chinese Education, 6*(1), 81–104. https://doi.org/10.1163/22125868-12340075

Wieser, D. (2020). Integrating technology into the learning process of higher education: A creative inquiry. *Industry and Higher Education, 34*(3), 138–150. https://doi.org/10.1177/0950422219895773

Zhong, B., & Li, T. (2020). Can pair learning improve students' troubleshooting performance in robotics education?. *Journal of Educational Computing Research, 58*(1), 220–248. https://doi.org/10.1177/0735633119829191