Analysis of role of information technologies in the organization of the educational process in higher educational institutions of Ukraine in the conditions of martial law

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Abstract.
The Russian-Ukrainian war, which began in 2014 and turned into a large-scale aggression by the occupying forces of the Russian Federation after February 24, 2022, led to significant changes in the priority forms of the educational process in the Higher Educational Institutions of Ukraine. In the conditions of martial law, introduced in the country on the day of the start of the large-scale invasion, mixed and distance learning became the forms of providing educational services that, based on the active use of information technologies, were able to ensure a quick recovery of the educational process with minimal financial costs for its organization.

Keywords:
- information technologies
- distance learning
- learning management system
- informational and educational environment
- mixed learning
- presence effect
- augmented reality
- 3D model
- educational simulator
For almost a year and a half, the Russian Federation has been waging the most brutal and bloodiest war in Ukraine since World War II. Only in the first year of the war 68,000 criminal proceedings have been registered under Article 438 of the Criminal Code "Violation of the Rules and Customs of War" and every day 100-200 new proceedings are added to this number. Crimes against humanity are quite difficult to control, but it is already known about thousands of kidnappings of people in the newly occupied territories of Ukraine, which are accompanied by torture and inhumane treatment. Since the beginning of the Russian invasion, more than 7 million Ukrainians were forced to leave their homes, but remained in Ukraine, almost 4.9 million Ukrainians officially received the status of internally displaced persons.

According to the data of the Ministry of Reintegration of the Temporarily Occupied Territories of Ukraine on April 22, 2023 the number of Ukrainian children deported to Russia already may reach from 16 to 300 thousand. About 1,000 children have been injured. The irreversible losses of human capital are simply terrible: as of the morning of April 22, 2023, as a result of the large-scale aggression of the Russian Federation in Ukraine, about 500 children have already died; the number of human victims among the civilian population has already reached almost 10,000 according to official data, and among the military, this figure is also within the same limits (the UN emphasizes that these figures are only verified and documented deaths, and the real number of dead is much higher). 81,000 Ukrainian civil infrastructure objects were destroyed, including 62,000 residential buildings. In the period from October 2022 to February 2023, 77% of Russian strikes fell on critical infrastructure objects, which led to the fact that the population of the country during the season of low temperatures was forced to suffer from the lack of heating, light, cold and hot water in the houses.

According to operational information MES of Ukraine as of August 1, 2022, as a result of large-scale RF invasion on Ukraine territory on February 24th, 2022, it was damaged 2200 Educational Institutions of Ukraine, including 225 were completely destroyed, 1975 partially damaged.
completely destroyed - 7 IHE. The number of damaged IHE and post-graduate pedagogical education institutions is numerically greater. This number reaches 49. The most damaged IHE were in the Kharkiv (21) and Donetsk (6) regions (together 58.7% of the total number of damaged IHE). They experienced the greatest amount of destruction and damage to their real estate objects V. Karazin Kharkiv National University, “Chernihiv Polytechnic” National University, State Tax University (Irpin), G. Skovoroda Kharkiv National Pedagogical University, Mariupol State University, Azov Technical University (Mariupol), T. Shevchenko Luhansk National University (newly built building in Rubizhny, Luhansk region), M. Zhukovskyi National Aerospace University "Kharkiv Aviation Institute" and others.

Direct damage from a large-scale invasion is estimated at 140 billion dollars, and indirect damage is five times more. All these actions are the act of genocide of the Ukrainian people, as well as the thesis of the russian president, which was proclaimed by him on the first day of the large-scale russian aggression against Ukraine about "denazification".

Immediately after the introduction of martial law the Ministry of Defense of Ukraine (MD) and the Ministry of Education and Science of Ukraine (MES) began to find the ways restoration of the educational process in Educational Institutions of Ukraine. MES of Ukraine appealed to well-known global corporations and companies in the field of digital industry for charitable assistance for the rapid restoration of the educational process in the country in the conditions martial law. The result of these negotiations was: providing Google and Microsoft corporations with access to their educational software packages and supporting the processes of providing Ukrainian educators with additional devices for learning; free access to ZOOM products; reaching an agreement with the leaders of the online education market - Coursera, Udemy and edX platforms to provide free access to courses to Ukrainian students; implementation of the launch of e-documents about education in the "Diya" mobile application to ensure equal opportunities for access to education and employment for all citizens of Ukraine with the support of the EU4DigitalUA project (Academy of electronic
governance (e-Governance Academy)); dozens of IHEs of Ukraine received the Starlink satellite Internet communication system manufactured by SpaceX, which enabled them to provide their students with access to educational electronic learning resources, libraries, repositories, LMS educational platforms and other resources with a stable high-speed Internet connection; free provision by the manufacturer of computer equipment - HP company, of its devices to Educational Institutions of Ukraine; signing an agreement with Vodafone, Lifecell and “Kyivstar” on providing unlimited, non-tariffed access to DL services and much more [1].

In order to successfully carry out the educational process in mixed and distance forms, Educational Institutions were recommended to use in their work the following information technologies (IT): learning management systems (LMS) (MOODLE, Google Workspace for Education, Microsoft Office 365 Education, etc.); applications for conducting video conferences and webinars (BigBlueButton, ZOOM, Microsoft Teams, Google Meet, etc.); e-mail; messengers (WhatsApp, Signal, Telegram, Viber, etc.); communication in telephone mode; electronic versions of textbooks; video-lessons from leading Ukrainian and foreign lecturers; live broadcasts-streams; forums; chat rooms; placement of tasks and recommendations on the institution's own website; the resources of the educational platforms Coursera, Udemy and EdX; simulation models of objects and processes (3-D models, flesh-animation, educational cartoons and computer educational games) visualize information and make the content of distance courses (DC) as visual and understandable as possible for the user, regardless of the degree of complexity of the material that need to learn; educational simulators which use technologies of augmented reality; the alternative Internet communication networks, IT of double password, thorough identification, cryptographic protection of information are widely used Higher Military Educational Institutions of Ukraine (HMEI) in their work on the organization of the educational process at a distance in order to ensure the defense of information with limited access and much more different IT [2].

The innovative IT, which are actively used in the
The educational process of various Educational Institutions of Ukraine for the organization of mixed and distance forms of learning in the conditions of martial law, rightfully include: the “progressive” electronic TABLE offered by the “OPTIMA Education Center”, which allows its owner to observe the dynamics of changes in the success of education depending on the number of tasks/tests completed in the relevant discipline; remote lectures, practical classes, seminars in the STREAM format (for example, in the YouTube application) with parallel online communication of the participants of this live broadcast in the chat of this DC - live broadcasts-streams (used in the practice of the implementation of DL by the Academy of Digital Development) (Fig. 1); the GitHub web service has proven itself well in practical classes on the disciplines of studying IT technologies for the convenient work of a team of students when they create a joint software application (this service is actively used in the educational process by the Kyiv School of Programming - ProgAcademy) [1,2].

Also unique for the educational process became a version of educational video content, created at the Department of
Biomedical Engineering (BME) of Kharkiv National University of Radio Electronics (KNURE), which is designed for laboratory work in technical disciplines, which uses complex hardware. This content is based on the use of modern video technology with the effect of presence, which allows the user during such a remote lesson to face the maximum possible level of clarity and reality when working on complex equipment with macro and micro review, demonstration of different devices separately from each other and all together. The panoramic video that underlies this content allows the DL student to have the yourself field of vision, not the video operator who shoots the classroom or computer class, the classroom or the laboratory. Content based on the use of modern video technology with the effect of presence is a combination of the newest technologies and explanations in chalk on the blackboard. This is a real effect of presence in the classroom, where there is a lecturer who demonstrates and explains the principles of equipment, and students at their workplaces in cyberspace (Fig. 2) [3].

Figure 2
Unique educational video content is based on the use of modern video technology with the effect of presence (KNURE)
Also, teachers of the Department of BME KNURE conduct classes remotely using the newest teaching aids, such as graphics tablets and interactive screens. This allows lecturers to perform transformations of mathematical expressions and write fragments of program code when conducting remote classes in dynamic mode while demonstrating the screen. This, in fact, combines the approaches of teaching in the blackboard and the presentation of material in the form of a presentation and significantly expands the methodological possibilities of conducting classes remotely during the demonstration of the screen [3].

The Department of Microprocessor Technologies and Systems (MTS) of KNURE has two laboratories with remote access to equipment (on-line laboratory), where students can create a project in real time and test its viability outside laboratories. Laboratory classes are conducted using the MOODLE platform (dl.nure.ua), video conferencing in Google Meet and remote access to PCs and laboratory layouts. Students and lecturers use the TeamViewer remote software package to remotely access PCs in laboratories. Adjustment of laboratory equipment and support during laboratory work is provided by teaching and support staff of the Department. For laboratory work, the newest equipment is used, which has the ability to connect to a PC. Laboratory models and oscilloscopes are completely controlled by a personal computer. And with the help of the camera the work of the laboratory model is broadcast on the monitor. This allows students to upload projects to laboratory layouts remotely and view the results of their work on a computer monitor using specialized software. This approach to laboratory work on microcontroller design allows students to gain hardware skills, practical microcontroller programming skills, and provides students with additional skills for remote hardware operation [3].

To the significant achievements in the direction of creative application of information technologies in the educational process by the scientific and pedagogical personnel of KNURE includes the experience of passing exams and defense of coursework, bachelor's and master's qualification theses. The algorithms for conducting these educational events meet the requirements of the MES regarding
their organization in a distance form, and the software application chosen for communication between the lecturers and the student during their implementation was chosen the same and it is Google Meet [3].

Two educational shells are actively used in the educational process of NTU (KPI) - “KPI Web Class” and “Information Management System” (“CIM”), developed and manufactured by the university specialists, as well as the freely distributed MOODLE shell [1-3].

The Moodle shell is used mainly as an experimental base for scientific and methodological work and for the implementation of corporate projects in the field of e-learning. Moodle has more than 90 distance learning courses. The “KPI Web Class” training shell has been operating since 2001. With the help of this shell, more than 200 distance learning courses have been developed (Fig. 3).

The shell “CIM” has been developed by scientists of this educational institution and functioning since 2004. It is a...
learning management system (LMS) which includes more than 250
distance learning courses and its most basic parameters meet
the requirements of the international standard of SCORM. “CIM”
is a software complex that provides the work of teachers and
students in any distance learning format - consulting,
resource and instruction. The methodological principle of
building “CIM” is the distribution of responsibilities among
the participants of the educational process. This approach
give an opportunity to create a maximum user-friendly computer
desktop interface for teachers, students and other users,
that do not require special programming knowledge - enough
only elementary skills of working with Internet browsers. An
important feature of “CIM” is a developed system of
administration of the educational process, which actively
uses a rating system of evaluations and modular control and
provides a detailed tracking of educational activities of
teachers and students (Fig. 4) [1-3].

An important element in the training of a true specialist
is undoubtedly a large number of practical classes. It is for
This purpose that cadets of National Academy of National Guard of Ukraine (NANGU) study on dynamic simulators. The simulators are designed to simulate anti-tank missile systems "Fagot", "Stugna-P", "Corsar" and anti-aircraft missile system "Igla", "FIM-92 Stinger" and simulate real combat conditions. To develop skills in the use of weapons, cadets practice fighting enemy armored vehicles and aircraft. Simulator software allows you to simulate any background and weather conditions, which brings these actions as close as possible to real ones. During the training of practical actions, fire training instructors use simulator software to simulate the target, background situation, and set up active and passive obstacles (Fig. 5) [4].

![Image](image_url)

**Figure 5**
The special training simulators for honing the skills of shooting from anti-tank and anti-aircraft missile systems (NANGU)

The driver cadets of NANGU also study their future profession with the help of modern technologies. In Academy functions specialized automobile classes. They are equipped with new stands, models of automotive equipment and aggregates as well as interactive technical means, which really makes each every lesson a real discovery for future officers (Fig. 6) [4].
The special training simulators for honing the driving skills of cadets of NANGU

Also in the fire complex of the NANGU, practical classes on fire training are regularly held with cadets of all faculties. First, the cadets work on theoretical issues, study tactical and technical characteristics, the purpose of the BM-7 "Parus" combat module and the BTR-4E armored personnel carrier and their material part, and later move on to working out the practical part. In the second year of study, cadets study theory and practice practical tasks on dynamic simulators BTR-4E (Fig. 7) [4].
The informational and educational environment «DIALOG», the universal system for the development and conducting of computer tests, the complex of designing the academic schedule «CASCAD», an interactive educational and training complex for fire training «Learn to shoot accurately» («AK74 Trainer»), the complex simulator are own IT-developments of Kharkiv National Air Force University (KNAFU) (Fig. 8-11) [1-3, 5-7].

As a result of conducting research on increasing the effectiveness of combat training through the use of distance learning technologies, the informational and educational environment (IEE) «DIALOG» has been developed by KNAFU scientists in 2008, and is DLS which allows: to plan training by distributing subjects by type of training; to study as a group according to the subjects for which they are studying; organize classes in accordance with the requirements of the orders of the Ministry of Defense Ukraine regarding the training of military specialists; to carry out automated control of testing of those who learn with automatic fixing of time and results of passing tests; control the process of learning by the average score for the group, the course through the system of statistical data generation (Fig. 8).
The universal system for the development and conducting of computer tests has been developed and implemented in KNAFU (Fig. 9).

![Diagram of the test parameters window](image)

**Figure 9**
The window for creating (editing) the test parameters of a universal system for developing and conducting computer tests

The developed software application allows to solve the following tasks: locally, on separate PCs, to develop computer tests and conduct testing and self-control of those who study; choose the types of answers to questions (with one correct answer, with a few correct answers, with a response in the form of a record); divide the questions by category and type of answers and give the corresponding number of points for the correct answer; to randomly distribute questions by categories; use as a matter of a variety of document fragments (graphic, formulas, etc.) from other programs (MS Word, MS Excel, etc.); enter type of time limit and time limit; to pass the test and return to the questions; at the end of the
test, analyze the responses [5–7].

The main advantages of the software complex «CASCAD» are: it is an unique software product, created at the university, which fully corresponds to the content of all stages of the planning of training sessions for the semester; automatic control of the formation lessons schedule according to the defined criterions of the quality of the lessons planning; automatic fixing of all user actions to change data; automated formation of reporting (statistical) documents for the planned learning process (Fig. 10).

The user interface of software complex “CASCAD”

The scientific and methodological recommendations on the use of the "AK74 Trainer" (an interactive educational and training complex for fire training "Learn to shoot accurately") (Fig. 11) were developed by specialists of the KNAFU in co-authorship with colleagues from the NTU (KPI) already after the large-scale armed aggression of the russian occupation forces on the territory of Ukraine. Its aim to give cadets and university personnel, within the limits of
the relevant DC, the opportunity to learn how to use this simulator as efficiently as possible, while reducing the time for high-quality training in matters of accurate shooting and significantly reducing the material and financial costs of this process. The software of the complex was created for the preparation of data for firing with various types of weapons and the possibility of reproducing the trajectory of the bullet in space, taking into account the ballistic data of the weapon and selected weather conditions. This DC is a resource located on the "DLS KNAFU" service [6].

![Image of interface interactive educational-training complex "Learn to shoot accurately"](image_url)

**Figure 11**

*Original appearance of interface interactive educational-training complex "Learn to shoot accurately"*

Also in the educational process is successfully used the distance learning system with the open source code LMS MOODLE, BigBlueButton and ZOOM platforms for conducting and participating in scientific conferences in their distance version and for the acquisition of knowledge in various disciplines by the staff of educational institutions through distance courses for professional development (Fig. 12-15).

The faculty of contract training of reserve officers, like all other faculties of KNAFU, actively uses the “DLS
KNAFU” service for teaching academic subjects in a distance format. DCs in the disciplines taught at the faculty are as close as possible to their analogues for full-time study and contain almost completely the same material, which today is possible to turn into an electronic version by means of modern IT. The difference in the material can also be observed in connection with the requirement for the complete absence of any information of a confidential nature in the material of any DC HMEI of Ukraine. A vivid example of the successful preparation of the content of the educational discipline material in its distance format is the educational discipline "Military Training". The DC material is structured taking into account all the basic requirements for the formation of distance content; graphic editors were used to create illustrations, which allow you to clearly and visually display the information of the course; flesh-animation adds dynamics for a more complete understanding of the complex processes studied in this discipline; different types of tests are used to test knowledge, which enable the teacher to understand in more detail the degree of assimilation of each of the citizens who master the course of the educational discipline [3].

![Figure 12](image_url)

*Figure 12 Using of LMS MOODLE by MITIT as a platform for conducting of Cybersecurity distance course for staff of KNAFU*
For the training of military pilots on helicopters, KNAFU actively uses the complex «Mi-8 MTV» helicopter simulator (Fig. 16) [8]. The complex helicopter simulator is a set of equipment consisting of a helicopter cockpit with real controls, a visualization system, and an instructor's workplace. The simulator is intended for training and training of crew members in accordance with the "Flight Operations
Manual” using training concepts: LOFT (Line Oriented Flight Training) – training in real conditions and on a real time scale; CRM (Crew Resource Management) – crew resource management, information sharing methods, and crew member interaction.

Figure 15
Using of ZOOM platform by staff of KNAFU for participating in scientific conferences in distance version from NAA

Figure 16
The complex simulator of the «Mi-8 MTB» helicopter
The Mi-8 MTV helicopter simulator is a modern digital helicopter simulator. It is a complex dynamic system built on the principle of a multi-channel electronic circuit. This system is managed by a large number of programs based on various algorithms and mathematical models. The correct application of theories generally accepted in the practice of helicopter construction and adequate mathematical models made it possible to simulate the flight dynamics of a real helicopter with a high degree of accuracy on the simulator. Exercise machines of this series "on mobility" are of particular interest. When training pilots, the maximum effect is achieved on them. Such a simulator gives more realistic sensations: overload; effects of inertial and centrifugal forces; a vortex ring and various "visual" phenomena are simulated. When the simulation of the vortex ring works, there is a very strong vibration, overloads are felt and there is even the possibility of hearing sound. Realistic feelings during piloting on the simulator – guarantees the acquisition of full-fledged long-term skills by those who undergo training on them.

Thus, the analysis of the degree of application of information technologies by Higher Educational Institutions in their activities regarding the organization of the educational process during the large-scale aggression of the Russian occupying forces on the territory of Ukraine allows us to assert that the role played by these technologies is huge and invaluable. No one will ever be able to defeat the Ukrainian people, let alone destroy us and our state – UKRAINE! Our knowledge is our power and using of information technologies in educational process brings us closer to our Victory!!! TOGETHER TO VICTORY!!! GLORY TO UKRAINE!!!

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