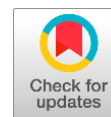


Education in the conditions of war: advantages and disadvantages



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Abstract The research aims to study the peculiarities of education in wartime. Despite many challenges that have arisen as a result of Russian aggression against Ukraine, the modern higher education system has development opportunities. The first of these is international academic mobility, which provides opportunities for teachers and students to attend leading European universities. The second is the intensive introduction of information technology into the educational process and the professionalization of teachers. The third is the use of flexible learning technologies, and the fourth is a cooperation between Ukrainian and foreign higher education institutions. The fifth possibility is the introduction of the "lifelong learning" model, and the sixth is distance learning, which can be a full-fledged form of education in some specialties. For students, this form of education allows them to study and gain practical experience at the same time, and for teachers to work in education and other fields, passing on practical experience to students. The seventh possibility is to improve the territorial organization of higher education in Ukraine, in particular, to relocate higher education institutions from areas where active hostilities are taking place to large cities. Improving the territorial organization of higher education in Ukraine (relocation of higher education institutions to large cities from areas where active hostilities are taking place) is worthy of attention. Finally, the ability to identify hidden problems in the higher education system and work on solving their causes. The key is to identify threats timely and develop mechanisms to mitigate their impact. Each opportunity should be realized to the fullest extent possible. All these points should be considered in the operational plans for the implementation of the Strategy for the Development of Higher Education in Ukraine for 2022-2032. It is concluded that technological influences are used in modern life to achieve various goals, including obtaining confidential information. User training and increased technical protection are the best defenses against social engineering attacks. To reduce the occurrence of social engineering attacks, technical protection is needed to help prevent such attacks.

Keywords: higher education, martial law, state engineering, distance learning, innovation potential, education reforms

1. Introduction

Introduction. During the years of Ukraine's independence, several important reforms have been carried out in the higher education system, aimed at preserving the progressive traditions of the past, as well as at achieving compliance with new social relations and accumulating innovative potential for further development. The most significant changes in higher education occurred after 2014 when the progressive laws of Ukraine's "On Higher Education" (2014) and "On Scientific and Scientific-Technical Activities" (2015) were adopted. However, the war in Ukraine, which began after February 24, 2022, has made significant adjustments to this process. Despite its devastating impact on the socio-economic development of Ukraine and its regions, it still opens up access to new opportunities for each sector of the national economy, including education. The war is having a profound effect on the quality of education. Some students started studying online, but due to the lack of electricity, they lost the opportunity to study systematically. Some were forced to leave the country in search of safety and faced a language barrier. Thus, there are many such problems, it is difficult to list every single one of them.

Even if students have the opportunity to continue their education, they may lose motivation or lack the moral resources to study. This can have long-term consequences for their future, such as a lack of qualifications and low educational attainment, which can prevent them from pursuing a career and earning better wages. There may also be a deterioration in mental and physical health and reduced social adaptation. The question of how to reduce the impact of war on children's education is important. To reduce the negative impact of war on children's education, efforts are needed to ensure security and stability in the education system, as well as access to resources and support for children and their families. Additional efforts are also



needed to address inequalities and inadequacies in the education system that may be more pronounced during the war. It is also important to continuously monitor and evaluate the education situation during the war and implement an adapted and accessible education program to ensure that children are maximized in educational opportunities in such difficult circumstances.

The development of innovative and distance learning methods that can be applied in extreme situations can also be a useful solution to improve access to education during war.

It is essential to remember that students living in a war zone not only have to cope with danger and instability but also with psychological and emotional stress.

Students may suffer from trauma, stress, fear, and loss. Psychological assistance and support for children should be provided to help them better adapt to the situation and maintain their mental and emotional well-being. Access to education requires addressing numerous challenges.

First, education in times of war is an important topic that requires cooperation between government agencies, aid organizations, and the international community to maximize educational opportunities and protect children in such difficult circumstances.

Cooperation with local organizations, social workers, and independent experts is needed to ensure adapted and accessible educational opportunities for children.

Secondly, to ensure access to education during war, it is necessary to provide sufficient financial resources, appropriate infrastructure, and equipment.

Thirdly, it is important to remember that education in times of war is not limited to book learning. Students need a variety of educational opportunities that include social and emotional support, cultural activities, and access to media and technology.

Fourth, education should be adapted to the war situation and meet the needs of children to help them adapt to life in difficult conditions in the future.

And most notably, one of the key aspects of education in times of war is ensuring the safety of children and teachers. During the war, schools are often targeted, resulting in loss of life and destruction of equipment. Schools need to be secured to protect the lives of children and teachers and ensure the continuity of the educational process.

Furthermore, education in the conditions of war should be accessible to all children, regardless of their social status or religious affiliation. War-related migration and unequal access to education can lead to discrimination and exclusion of some children. It is imperative to provide accessible and equal educational opportunities for all children to prevent discrimination and ensure equal chances for all children in the future. This requires cooperation with local organizations, social workers, and independent experts to develop and implement strategies to ensure that education is accessible to all children during the war.

Overall, war has a significant negative impact on education, but with the right efforts and support, it is possible to mitigate these effects and help children in the future.

The research aims to study the peculiarities of training in war conditions.

2. Methods

The study uses general scientific methods, in particular, comparative, analytical, comparative, inductive, deductive, and the method of definitions.

3. Theoretical background

The scientific works of the following authors are devoted to various aspects of the development of education, regional educational systems, the impact of educational innovations on the development of the national and regional economies, as well as the relationship between the development of higher education and the construction of an information society in the state (Leon 2012), (Kesternich et al 2014), (Kapor-Stanulovic 1999), (Justino et al 2013), (González and Bedmar 2012), (Glasgow, and Baer 2011), (Gerardino 2014), (Chamarbagwala and Mor'an 2011), (Cerna 2019), (Cano and Cervantes-Duarte 2016), (Blattman and Annan 2010) and others.

However, despite the significant developments, (Auzina 2002), (Berezivska 2002), (Sazonenko 2000), (Danylova 2006), (Rezvan 2012), (Akbulut-Yuksel 2014), (Akresh and De Walque 2008), (Akresh 2016), (Annan, Blattman, Mazurana, Carlson 2011), (Alfano and Görlach 2019) there are still issues that are particularly acute for scholars and require in-depth research. In particular, this includes identifying and analyzing the challenges and opportunities facing Ukraine's higher education system in wartime. Factors of depression and mental health anxiety in nurses were identified using a quantitative cross-sectional study (Tsaras et al 2018). By applying a comparative analysis, the pregame expected mental state of players in mini-football teams was studied (Popovych et al 2021). Improvement and study of computer modeling based on open and specialized geoinformation systems by students and postgraduates (Iatsyshyn et al 2020). The use of professional qualities of managers in training entrepreneurship and e-commerce (Akimov et al 2021) to prevent creative burnout of public administration employees

(Kryshtanovych et al 2022), and self-regulation of mental states during responsible activities (Popovych et al 2022), and mental burnout based on the determination of the emotional quotient (Popovych et al 2022).

4. Results and discussion

The full-scale invasion of Ukraine by the Russian Federation and the introduction of martial law have made adjustments to virtually all areas of public life, including the higher education system. During martial law, it faced new challenges that have to be addressed to preserve higher education in Ukraine and increase its contribution to the socioeconomic development of the country and its regions. These challenges are as follows:

1. Destruction of the infrastructure of HEIs. Despite the difficult situation in higher education in Ukraine, many HEIs are currently suffering from the devastating effects of the war. The vast majority of universities have faced a territorial "dispersion" of students and staff and have switched to distance or blended learning. The situation is most critical in the universities located in the areas of active hostilities. Students and staff were forced to leave the region. As a result of intense shelling and bombardment, the infrastructure of these higher education institutions suffered varying degrees of damage and destruction.

Furthermore, 34 higher education institutions have been relocated or are in the process of being relocated, including the University of the State Fiscal Service, Luhansk Shevchenko National University, Donbas State Pedagogical University, East Ukrainian Dahl State University, Ukrainian Military Medical Academy, Luhansk National Medical University, Ukrainian Engineering and Pedagogical Academy, and Priazovsky State Technical University. These are mainly institutions from Luhansk, Donetsk, Crimea, Mariupol, Kramatorsk, Sloviansk, Kherson, and Sumy. The conditions in which the relocation was carried out differ for these institutions. However, most of the problems at the new locations are similar. In particular, this includes the need for:

- computer, office, and network equipment to resume educational and scientific processes;
- laboratory equipment in key research areas;
- the creation of scientific bases from leading universities and research centers.

It should be noted that without the creation of targeted funds for reconstruction, the provision of appropriate assistance to ensure the quality of education during and after the war, and the creation of strategic alliances between Ukrainian universities and partner universities for reconstruction and development, the further development of Ukraine's higher education system will be an extremely difficult and time-consuming process.

2. Reduced funding for higher education. Education and science in Ukraine have always been funded on a residual basis. The Law of Ukraine "On Education" provides for funding of the sector in the amount of at least 10% of GDP. It has never managed to reach this level of funding.

Taken together, all of the above may lead to the decline of higher education institutions in these regions and a deterioration in the quality of educational services.

3. Loss of human resources. There is a significant wage gap between the higher education sector and other sectors of the economy. In addition, the salaries of academic staff in higher education institutions in Ukraine are much lower than in leading countries. There is a significant regional differentiation in the remuneration of academic staff in higher education institutions subordinated to the Ministry of Education and Science of Ukraine. The highest average salaries are received by academic staff in higher education institutions in Kyiv, Kharkiv, Poltava, Ivano-Frankivsk, Lviv, and Dnipro regions. In particular, in 2019, the average salary of a research and teaching staff member at the Taras Shevchenko National University of Kyiv was UAH 22,991.56, the Ivan Franko National University of Lviv - UAH 12,360.68, and the Yaroslav Mudryi National Law University (Kharkiv) - UAH 27,716.03.

An interesting pattern is that in the HEIs in the West of Ukraine studied by Focus, the cost of a master's education showed the most intensive growth. For example, a master's degree in software engineering at the Western Ukrainian National University (Ternopil) increased in price by 37.4%. Perhaps this price increase is due to the increased demand created by immigrants from the war-torn areas of Ukraine.

At the same time, the cost of education in the surveyed universities in Kyiv has not changed or increased by only a few percent compared to last year. Therefore, there is a gradual decrease in the difference in the price of education between Kyiv and large regional centers far from the front line.

The cost of education, of course, partly depends on the popularity of the specialty. Traditionally, programming, law, journalism, and other social sciences are the most expensive. For example, at the Taras Shevchenko National University of Kyiv, a master's degree in law costs UAH 61,100, a bachelor's degree in journalism costs UAH 49,200, and a bachelor's degree in archeology costs UAH 31,800.

The situation is similar at Igor Sikorsky Kyiv Polytechnic Institute. While studying for a degree in software engineering costs UAH 45,000, studying for a degree in electronics costs UAH 16,600.

Low wages have led to a decline in the prestige of this type of activity. The conditions of martial law force higher education institutions to optimize the cost of remuneration for academic, research, and teaching staff by:

- 1) reduction of the number of additional payments for the academic degrees of Doctor of Philosophy and Doctor of Science, for the academic title of associate professor, senior researcher, and professor;
- 2) forced unpaid leave (in 2022, the annual leave will be 24 days, not 56 days);
- 3) redistribution of hours in the curriculum between the classroom and independent work;
- 4) downsizing of the staff. This encourages teachers to leave the profession and move to better-paying jobs or to be employed in foreign universities;
- 5) the outflow of Ukrainian and foreign students from HEIs. Foreign citizens from more than 150 countries can study in 240 Ukrainian universities and obtain higher education in various specialties. Before the war, Ukraine occupied 1.5% of the global market for foreign students. At the beginning of the 2021/2022 academic year, more than 76 thousand foreigners were enrolled in Ukrainian universities. The main reasons that have contributed to the growth of their number in recent years include the quality of education, tuition fees, recognition of diplomas at home, and the desire to study in one of the European countries.

The article provides enough information to understand how complicated the functioning of Ukraine's higher education system will be under martial law. It is also necessary to respond promptly to the socio-economic challenges of today to preserve and develop the system in the future. The Verkhovna Rada Committee on Education, Science, and Innovation has already outlined some pressing issues in the field of education and science that have arisen in connection with the introduction of martial law in Ukraine. The Ministry of Education and Science of Ukraine has proposed certain solutions to address them. In particular, these problems relate to:

- 1) audit of the infrastructure of losses;
- 2) development of a plan to restore educational infrastructure
- 3) the 2022 admission campaign
- 4) formation of a state order for training for 2022
- 5) audit of displaced higher education institutions;
- 6) adjusting tuition fees for contract students;
- 7) amendments to the Law of Ukraine "On Higher Education" to extend the term of the temporary staff of the NAQA;
- 8) studying the issue of establishing corporate higher education institutions and launching relevant pilot projects;
- 9) admission of foreigners to higher education institutions during the year;
- 10) creation of conditions for the return to Ukraine of applicants for higher education who went abroad due to the military aggression of the Russian Federation;
- 11) license conditions.

Unfortunately, they do not address the issue of preserving the country's scientific and pedagogical potential, which is no less important in today's difficult conditions.

Organizing students' education in software engineering requires a comprehensive approach, considering all elements of the well-established manufacturing process. It includes planning, design, development, testing, and software deployment. Additionally, considering the growing prevalence of remote work models in internationally distributed teams, sufficient attention should be given to skills in utilizing relevant development tools, communication, language proficiency, etc.

Ukraine's current political and economic situation favors conducting online classes. Apart from teaching the core subject, this allows for simulating communication and knowledge sharing among software development teams in specific work modes.

This approach has the drawback of the lack of non-verbal communication, which is an essential source of additional information and aids in better assimilation of the learning material. Moreover, live communication enhances interaction among team members, encourages mutual support, and creates a conducive work atmosphere. These are particularly important for young programmers unfamiliar with corporate culture and without life experience.

Therefore, to mitigate the aforementioned drawbacks, the preparation of not only programmers but also IT specialists, in general, should be conducted through a combined approach of remote and classroom sessions as soon as the situation allows.

The following tools are used for both educational and manufacturing processes of software engineering, namely:

- communication tools, including video conferencing programs and collaborative document editing.
- integrated development environments.
- version control systems, including web-based repositories, including public ones.
- code quality control systems.
- programming language processors, dependency managers, and project build systems.
- containerization tools.

With the help of the aforementioned tools, it is possible to organize activities where several students work on the same project simultaneously. Starting development in the classroom, they continue their work at home, implementing functionality needed for the next session and exchanging results online. The project build process is automated and executed within a container, ensuring its functionality in any environment. The verification process can be automated in various aspects:

functionality, code quality, and development speed, utilizing the same elements and practices as real development teams. The educator remains responsible for final checks and evaluations. Along with implementing electronic document management in Higher Education Institutions (HEIs), flexible organization of professional training sessions becomes possible. It depends on the social, political, and economic circumstances, ensuring the continuity of the learning process.

This approach requires sufficient background knowledge in IT, making it unsuitable for students in introductory courses. Most of the mentioned tools exist in free (Open Source) versions. However, their installation, configuration, administration, and development of corresponding guidelines require significant effort, time, and qualifications. Only some things listed above are suitable for teaching basic subjects. Students develop a habit of relying on specific software tools, which is undesirable in terms of preparing a well-rounded specialist. The field's dynamic development necessitates almost yearly revision of the curriculum and the stack of supporting software.

On the other hand, this plan fits harmoniously with practical courses related to the study of object-oriented programming languages, databases, web development frameworks, version control systems, artificial intelligence, or machine learning. It engages students in hands-on projects, significantly improving their grasp of the material. They provide relevant and valuable work experience, including working as part of a team.

Analyzing educational processes in any world-class technical institution, we can observe the implementation of the ideas above to some degree. However, many questions still need to be formulated and addressed before a comprehensive vision can be formed. The overall organization of training in "Software Engineering" requires careful consideration of all elements involved in manufacturing processes. It includes curriculum planning, development of educational materials, precise and comprehensive testing, user account management, etc.

Applying this comprehensive approach guarantees the effective provision of high-quality education for IT specialists.

The concept of state engineering originated in the early 1970s and reflected a system of attacks on telephone operators. Today, engineering methods based on psychological mistakes in human behavior allow you to find out any confidential information and gain control of almost any information system. State engineering allows you to control the personnel of the information and computer system and the information and computer system itself. The entire information and computing system can be divided into several levels of hierarchy: software, which is nested in the hardware level, which in turn is nested in the personnel level. Nested layers are subordinate to meta-levels because the requirements of the meta-level serve as axioms for the nested layers. Thus, the higher the level of attack, the more opportunities to influence the information and computer system. The personnel layer is the highest level for software and hardware. The personnel level itself is included in various types of assurance, such as regulatory assurance, which includes laws and regulations that govern the activities of people. Based on acts or laws, a person performs certain actions. The state engineer influences the level of personnel of the information and computer system, which allows him to successfully level almost all software and hardware protection. The goals of state engineering are simple: to increase trust, collect statistics, and provide access to confidential data. At the same time, the state engineering model has its peculiarities. When we talk about the object of state engineering, we mean a set of personal qualities of people who are the most important carriers of information. The object can also be human qualities, such as loyalty and trust. As for the methods of state engineering, they are aimed at correcting people's behavior so that they act voluntarily and independently in the right direction. Why have state engineering methods become so popular today? State engineering has many advantages, namely simplicity and low risk, no need to use sophisticated technical means, and, most importantly, high efficiency. State engineering is particularly vulnerable because it relies on human error rather than vulnerabilities in software and operating systems. Mistakes made by legitimate users are less predictable, making them more difficult to detect and prevent than malware intrusions.

The analysis shows that the educational activities of most higher education institutions have received a strong impetus for development. However, the situation is complicated by the fact that in recent decades (after the 2000s) the education system has undergone significant changes that have reduced its flexibility and adaptability. On the one hand, the transition to international standards allows for the expansion of graduate employment, but on the other hand, serious financial savings in the higher education system have led to a decline in the quality of training of specialists, the demand for which is not growing at the desired pace. During the war, the situation was complicated by the fact that to maintain a stable student population, the formal approach to the educational process was strengthened by both students and teachers. The International Association of Universities survey analyzed the barriers to development for universities during wartime. The barriers to development for universities during the war include reduced academic mobility, weakened partnerships necessary for the development of new master's programs and new research projects in which master's students can participate, and other problems. According to the research center, despite the negative consequences, the war still provided opportunities and an understanding that in the modern world, it is necessary to be able to bridge the digital divide and learn to withstand various threats. The scientist also believes that narrowing the digital divide can ensure sustainability in the most important sector of human development - education.

The global higher education sector has been radically transformed. The transition to distance learning is only part of this process. Such a complex open system as higher education could not but be affected by the changes taking place in the economy, labor market, logistics, international communications, and other areas. During the military conflict, the main focus

of university management was on solving the following problems: preserving the lives and health of students and staff, maintaining the quality and accessibility of the educational and research process at universities (or fulfilling all three missions of universities - education, research, and support of the social environment), and cutting costs and finding new resources.

5. Conclusions

Despite the challenges faced by the modern higher education system as a result of Russia's aggression against Ukraine, it still has some room for development. First, there are opportunities for international academic mobility for teachers and students at leading European universities. Secondly, there is an intensive introduction of information technologies into the educational process and professional development of teachers. Third, flexible learning technologies can be used. Fourth, cooperation between Ukrainian and foreign higher education institutions is possible. Fifth, the "lifelong learning" model is being implemented. Sixth, distance learning can become a full-fledged form of education for obtaining higher education in some specialties. Seventh, students have the opportunity to study and work simultaneously to gain practical experience, and teachers have the opportunity to work in education and other fields to pass on their practical experience to students. Eighth, it is possible to improve the territorial organization of higher education in Ukraine by relocating higher education institutions to large cities from areas where active hostilities are taking place. Ninth, it is crucial to identify hidden problems in higher education and work to eradicate their causes. The key is to identify threats in time and develop mechanisms to mitigate their impact. Every opportunity should be realized at the maximum level. All these aspects should be addressed in the operational plans for the implementation of the Strategy for the Development of Higher Education in Ukraine for 2022-2032. From all of the above, we can conclude that technological influences are used in modern life to achieve various goals, including obtaining confidential information.

User training and increased technical security are effective measures to detect and respond to social engineering attacks. To reduce the risk of such attacks, it is also important to use technical safeguards. In particular, detecting keywords in emails or phone calls can be useful in preventing potential attacks. However, it should be noted that even these technologies may be ineffective in preventing attacks carried out by skilled state engineers.

Ethical considerations

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Conflict of Interest

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