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Aplicación de las tecnologías de la información en el proceso educativo bajo la ley marcial

Application of information technologies in the educational process under martial law

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Resumen
El propósito de este estudio fue investigar el papel de las tecnologías de la información en la educación bajo la ley marcial en Ucrania, utilizando métodos matemáticos de análisis, análisis de datos estadísticos y entrevistas semiestructuradas. Se ha establecido que el proceso educativo llevado a cabo por las instituciones educativas ucranianas bajo la ley marcial garantizará la continuidad de la educación ya que los participantes en el proceso educativo cuentan con suficientes tecnologías de la información, así como los niveles básicos y superiores necesarios de alfabetización digital. Los resultados de este trabajo son de importancia práctica para los académicos y educadores que trabajan para mejorar las estrategias de aprendizaje a distancia de emergencia y el uso de tecnologías de la información en el proceso educativo. El aprendizaje a distancia en condiciones extremas es la única manera de que las generaciones más jóvenes no pierdan el tiempo esperando condiciones favorables para el aprendizaje. La investigación adicional debe dirigirse a la creación de métodos de estimación efectivos, conectados con las tecnologías de la información.

Palabras clave: Educación en línea, informática, alfabetización digital, ley marcial, guerra, agresión, Ucrania.

Abstract
The purpose of this study was to find out the role of information technologies in education under martial law in Ukraine, using mathematical methods of analysis, statistical data analysis,

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and semi-structured interviews. It has been established that the educational process carried out by Ukrainian educational institutions under martial law will ensure the continuity of education as the participants in the educational process are sufficiently provided by information technologies, as well as the necessary basic and higher levels of digital literacy. The results of this work are of practical importance for the scholars and educators working to improve emergency distance learning strategies and using information technologies in the educational process. Distance learning in extreme conditions is the only way for the younger generation not to waste the time waiting for favourable conditions for learning. Further research should be directed to the creation of effective estimation methods, connected with information technologies.

Keywords: Online education, computing, digital literacy, martial law, war, aggression, Ukraine.

Introduction

At a time when the whole world was in the post-vaccination period, preparing for reversing the pandemic (Reuter, 2020), Russian troops invaded the territory of Ukraine, which led to the beginning of a new crisis related to the war. To overcome it, the education system used information technologies, developed during the pandemic (Oliveira et al., 2021). Martial law has been introduced throughout Ukraine since February 24, 2022 (Ilnytska & Mykolaiko, 2022). To create safe conditions for learning, all educational institutions have been transferred to distance learning, focusing on the continuation of education, regardless of the forced displacement (Sokol & Melko, 2022; Sarnovska, 2022).

By the beginning of 2022, the world has already gained the experience of overcoming spatial and temporal limitations in extreme conditions, as well as problems of access to resources and preservation of people's health and well-being, including in the educational process (Karimian et al., 2022). During the 2020 pandemic, which affected the whole world and is considered the greatest threat to humanity after World War II, more than 1.5 billion students from 190 countries of the world had to change face-to-face education to distance learning (Doshmangir et al., 2020). Scientists and teachers tested a range of educational platforms, teaching and assessment methods, and quickly developed e-content and strategies to solve the problems that arose in the field of education, including virtualization, provision of technological support, involvement, information exchange, assistance, integration, the flexibility of training and its diversification, monitoring, etc. (Karimian et al., 2022).

Literature review

It has been proven (Havari & Peracchi, 2019) that wars have long-term consequences and negative impact on the education system even after several generations. To avoid this, it is

necessary to look for alternative forms of learning, suitable for use under extreme conditions. After all, it is education that can help build peace (Levi, 2019), and information technologies are the driving force of social changes (Moroz, 2021).

By the other hand, information technologies are an intermediary between students and teachers (Oliveira et al., 2021; Stepaniuk et al., 2022). The flexibility of education and its accessibility, provided by information technologies, make it possible to study at any time, convenient for students, and from any place on the planet, where there is access to the Internet. At the same time, information technologies provide an opportunity to implement an individual approach (Bordoloi et al., 2021).

In Ukraine, innovative information technologies have been actively used in educational institutions. Teachers and lecturers had a positive experience working with information technologies and considered it an integral part of both face-to-face and distance educational processes (Operchuk & Kasyanenko, 2022). The use of information technologies in the educational process makes it student-oriented and individualized (Bordoloi et al., 2021).

At the same time, information technologies were used not only as a tool necessary for the organization of education but also to ensure peace and security (Reuter, 2020). Some scientific research (Traxler et al., 2019) examined the role of ICT (Information and Communication Technology) in solving the problems of education during the Israeli occupation of Palestine, others like Tverdokhlib (2022) and Polukarov & Polukarov (2022) analyzed the possibilities of ICT in distance learning during the 2020 pandemic and the full-scale invasion of the Russian Federation on the territory of Ukraine (Pizintsali et al., 2022).

In general, the use of information technologies in education is interesting for students because they are engaged with the technologies and enjoy information technologies -enabled education (Galanek et al., 2018). The analysis of the technical characteristics of modern information technologies showed that for distance learning it is enough to have a mobile phone or tablet and mobile Internet with a speed of at least 3 Mbit/s (Tverdokhlib, 2022).

Therefore, the purpose of this work was to investigate the role and features of the application of information technologies in the learning process under martial law in Ukraine. To achieve the goal, it was necessary to solve the following tasks: 1) To determine what technological capabilities participants in the educational process had during the martial law in Ukraine; 2) To establish the level of formation of digital competencies of subjects of educational activity; 3) To study the peculiarities of the use of information technologies in the process of education under martial law. The criteria for the selection of goals became the definition of transformations in the use of information technologies in wartime to analyze the

technical capabilities of the participants of the educational process.

Methods

Design

This study was conducted in three stages. In the first stage, it was determined what technological capabilities students and teachers had during martial law. In the second stage, the digital literacy of the participants in the educational process, included in the sample, was determined. In the third stage, we found out the specifics of the implementation of the educational process during martial law in Ukraine and the role of information technologies in it. All materials used in the study met ethical standards and had a high degree of reliability, accuracy, repeatability, and validity. Mathematical methods and "Statistica" software were used to process the research results.

Participants

The sample included 23 European countries, which accepted the largest number of internally displaced persons from Ukraine, 117 students of 10-11 grades of general secondary education institutions, 293 students of I-VI courses of HEIs, 10 schoolteachers, and 18 university teachers. All the teachers were of different ages, from 25 to 73 years old, and had different teaching experiences from 2 to 38 years. The selection criterion was the residence and studying (teaching in an educational institution) on the territory of Ukraine until February 24, 2022. All participants gave written consent to participate in the study. Participation was voluntary, free of charge.

Instruments

To implement the first stage of the study, we carried out an analysis of statistical data, in particular, quantitative indicators of the forced displacement of the population of Ukraine, obtained from the Operational data portal Ukraine Refugee situation (https://data.unhcr.org/en/situations/ukraine/location?secret=unhcrrestricted); the number of mobile connections per 100 people in host countries and Ukraine (https://data.worldbank.org/).

To implement the second stage of the study, we used the statistical data from Eurostat concerning the digital literacy of the population of the host countries (https://ec.europa.eu/eurostat/databrowser/view/ISOC_SK_DSKL_I21/default/table?lang=en &category=isoc.isoc_sk.isoc_sku). The digital literacy of Ukrainian students and teachers, included in the sample, was determined using the Ukrainian Digital Competence Framework

(Ministry of Digital Transformation of Ukraine, 2021). It contains six areas, each of which includes 5 competencies and their descriptors. The evaluation criteria are presented in the Table 1.

Table 1
Criteria for evaluating digital literacy

The level of skills		Skills and abilities
Basic	A1	Solves simple tasks with outside help
	A2	Solves simple tasks individually (sometimes with outside help)
Average	B1	Solves routine tasks individually
	B2	Solves non-standard tasks individually
High	C1	Applies own knowledge and assesses the degree of complexity of tasks and problems and can manage the work of other users
	C2	Assesses the complexity of tasks and applies a creative approach to solving tasks with a limited range of possible solutions. Can contribute to professional practice and manage other users

Data collection

Semi-structured interviews with research participants were also developed and conducted online. Semi-structured interviews, conducted by the authors within 30 to 50 minutes via Zoom among 83 people, included in the sample, who during the martial law were forced to switch to distance education, but managed to continue the educational process thanks to information technologies.

Analysis of data

Data from semi-structured interviews were transcribed and coded. Answers are divided by topics. A content analysis of the received data was carried out. The results of the study are presented in tables and diagrams. Reliability analysis was performed using Cronbach's coefficient, which ranged from 0.76 to 0.81, indicating high reliability. Construct validity ranged from 0.73 to 0.82.

Results

To find safe conditions for living and studying, many students and teachers were forced to leave their homes and workplaces and move to safer places (sometimes outside the country). This paper analyses statistical data characterizing the largest flows of refugees from

Ukraine as of July 19, 2022 (Table 2) and quantitative indicators of mobile communication, that is, the number of mobile communication subscribers per 100 people. The digital literacy of the population of the countries, that accepted Ukrainians, has also been established.

Table 2
Technical capabilities and digital literacy of the population of host countries

Host country	The number of forced migrants from Ukraine as of July 19, 2022	The number of mobile communication subscribers (per 100 people) as of 2020	Percentage of people with basic or higher general digital skills as of 2021
Poland	1 234 718	130	43 %
Germany	893 000	128	49 %
Czech Republic	396 334	121	60 %
Italy	145 829	128	46 %
Spain	128 982	119	64 %
Great Britain	99 700	116	--
France	92 156	111	62 %
Bulgaria	86 584	114	31 %
Slovakia	85 771	134	55 %
Austria	76 210	119	63 %
Netherlands	68 050	125	79 %
Lithuania	59 472	135	49 %
Switzerland	58 007	127	78 %
Belgium	51 749	99	54 %
Portugal	47 847	116	55 %
Estonia	46 726	145	56 %
Romania	45 530	117	28 %
Sweden	42 319	127	67 %
Ireland	41 736	106	70 %
Latvia	34 583	109	51 %
Finland	30 372	129	79 %
Hungary	26 932	107	49 %
Norway	21 059	107	79 %
Ukraine	---	129	---

As shown in Table 2, a significant number of forced migrants from Ukraine moved to Poland. The local population of this country has skills in using digital devices and the same technical support with mobile communication devices as in Ukraine. For the other hand, Figures

1-6 present the results of determining the digital literacy of persons who were included in the sample of this study and who lived and studied in Ukraine before the war.

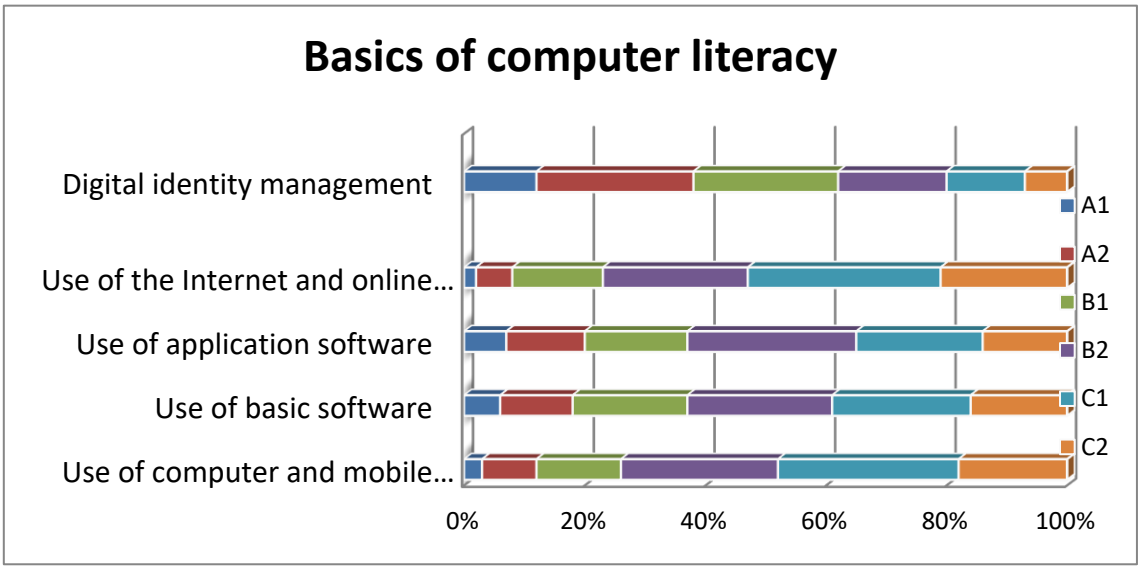

Figure 1. Results of determining the level of digital literacy of the population of Ukraine, included in the research sample

It was established that 12% of 10-11th grade school pupils, students, and school and university teachers have a basic level of computer literacy. That is, with the help of a third party, and sometimes independently, they know how to set up and use computer and mobile devices for their own needs (40% and 48% have an average and high level, respectively). Also, about 18% have basic skills in installing and using basic software, working with online services, various files, and Internet resources (about 39% have an average level).

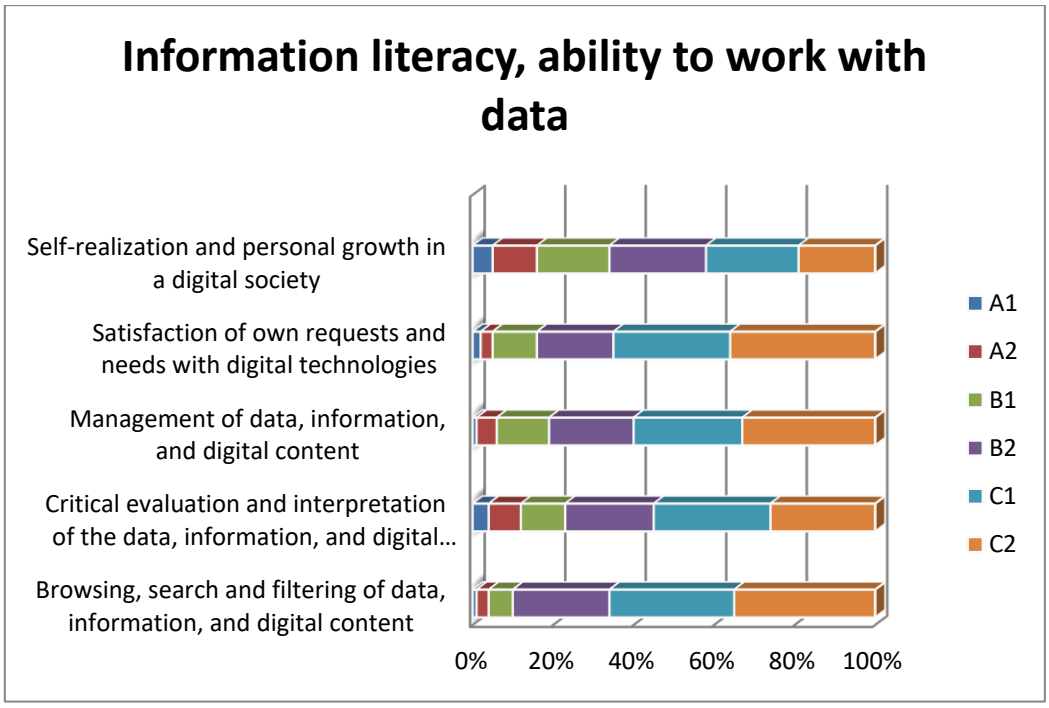

Figure 2. The results of determining the level of information literacy and ability to work with data of the population of Ukraine, included in the research sample

Most research participants have the skills of adaptation to different life circumstances and formulation of their own information needs and search for relevant data (Fig. 2); they can critically evaluate and verify the validity of the data found and can use these skills for self-education and in everyday life.

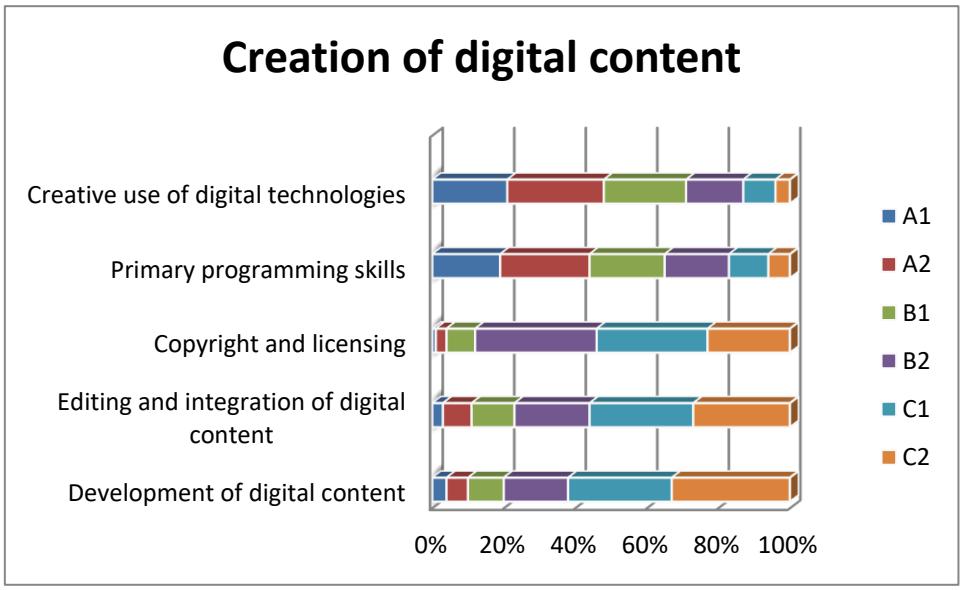

Figure 3. Results of determining the level of ability of the population of Ukraine, included in the research sample, to create digital content

As this research showed (Fig. 3), school pupils and students have the skills in processing digital content, and teachers know how to create it in the form of text information, multimedia, etc, and integrate information and content at a high level, while respecting the copyright.

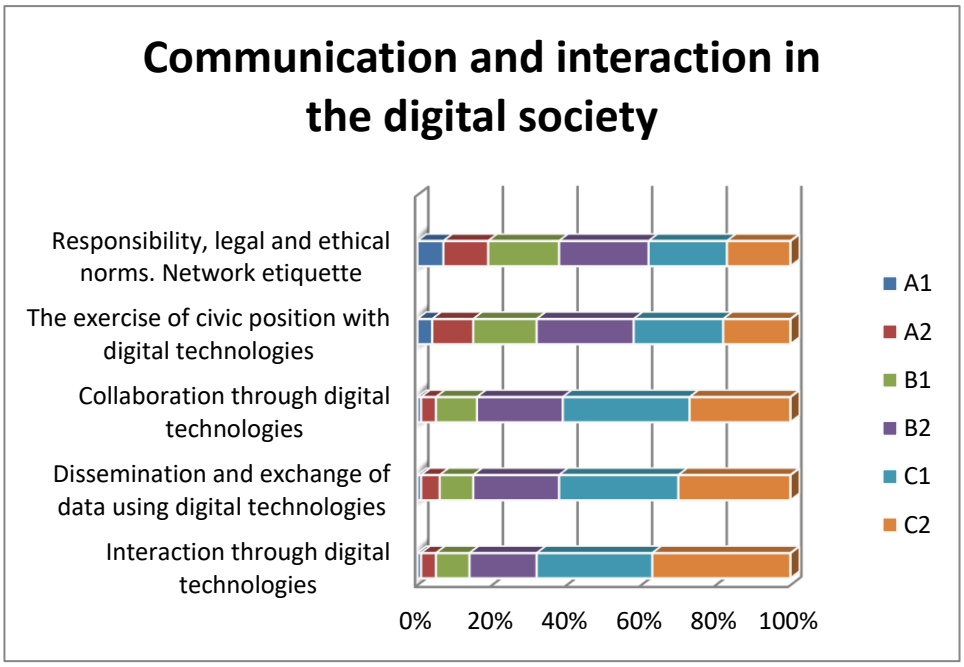

Figure 4. Results of determining the level of the ability of the population of Ukraine, included in the research sample, to interact in the digital society

Educators and their students know how to choose digital technologies for social interaction according to the purpose and situation and actively use them to distribute and exchange educational content. Due to teachers' moving abroad, it became necessary for them to use their digital signatures. As this study showed, 18% of them know how to use e-services at a high level. Teachers learned to adapt communication strategies to the needs and capabilities of a certain audience.

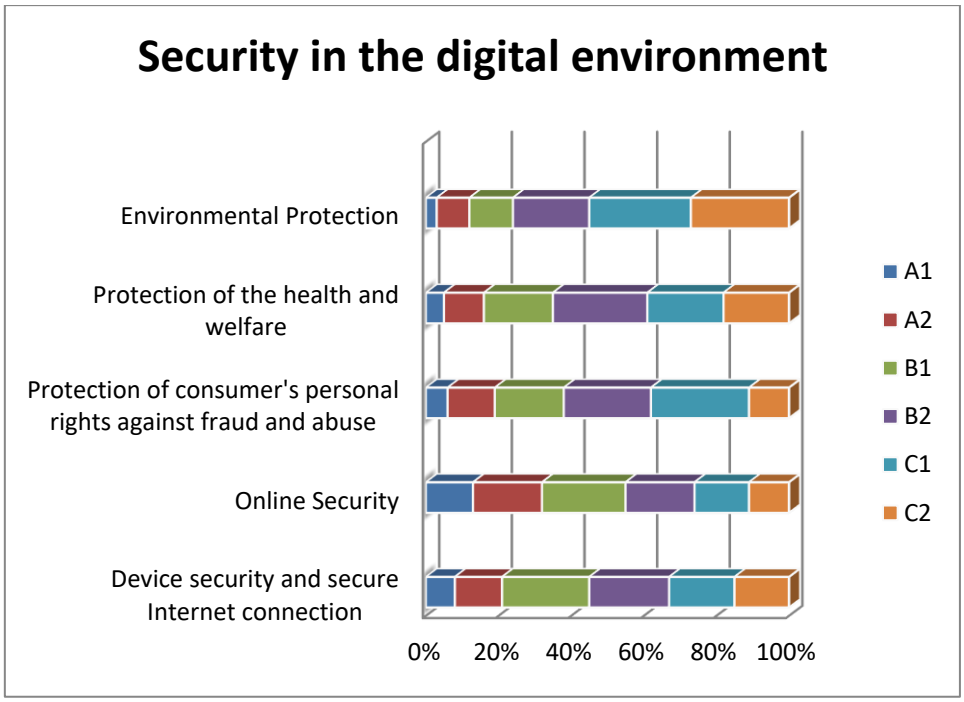

Figure 5. Level of ability of the population of Ukraine, included in the research sample, to use the digital environment safely

Participants of the educational process are aware of the dangers of using information technologies and 33% of them know how to protect their devices and digital content at a high level, considering privacy, and 39% can protect themselves from cyberbullying and phishing (Fig. 5).

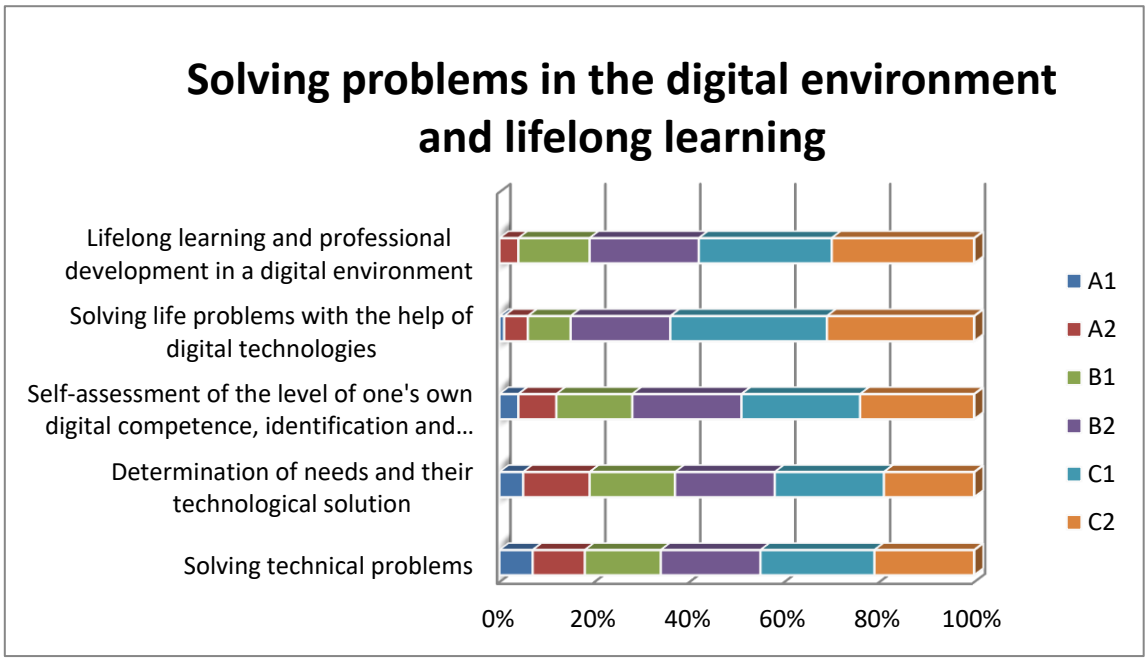

Figure 6. Results of determining the level of ability of the population of Ukraine, included in the research sample, to solve problems in the digital environment and use it for lifelong learning

The participants in the educational process, who were included in the sample, can identify technical problems that may arise in the use of ICT. They can independently choose digital tools according to their own needs, independently assess their digital competence and improve it with information technologies. Teachers and their students obtained personal development skills and skills of receiving self-education at any time and under any circumstances thanks to the long-term observance of quarantine restrictions and martial law, which caused the transition to distance education.

Table 3
Results of content analysis of semi-structured interviews

Question	Answer options	Number of responses in %
What events did you witness during the full-scale invasion of the Russian Federation troops on the territory of Ukraine?	Mass shelling	23 %
	My father joined the Armed Forces and defends Ukraine now	27 %
	I starved	19 %
Were you forced to change your place of residence in search of safety?	Yes	77 %
	No	23 %
Where do you currently live?	where I had lived until February 24, 2022	23 %
	Moved from the city to the village	25 %
	Moved to my parents' place.	29 %
When you left your home, did you think that you would be absent for a long time?	Yes	8 %
	No	69 %
What ICT did you take with you when you left your home?	Cellphone	77 %
	Laptop	36 %
	Tablet	24 %
In what form did you continue your studies (teaching)?	Synchronous	37 %
	Asynchronous	63 %
Was the technical support sufficient for studying/teaching in the chosen form?	Yes	41%
	No	59 %
By what means were synchronous and asynchronous courses provided?	Google Classroom	67 %
	Google Meet	31 %
	Zoom	84 %
How was the reproduction of educational materials provided?	By e-mail	27 %
	Through social networks	29 %
	Through the digital educational environment of the educational institution	43 %
	Through mobile applications	61 %
In what form was the educational material presented?	Electronic textbooks and a list of questions to be studied	44 %
	Lecture texts, sent by the teacher	39 %
	Video, selected by the teacher from YouTube	65 %
How were practical skills and abilities formed?	Practical issues were discussed during synchronous online meetings	73 %
	Through interactive teaching methods	49 %
How were the current control and final assessment of the level of acquired knowledge, abilities, and skills carried out?	By sending the photos of written works to the teacher for checking	59 %
	During the conversation using the online platform	67 %
	Through testing with the use of Internet resources	43 %

The interview showed that in martial law conditions, it was necessary to change the teaching strategies. For example, educational material was presented mainly in the form of videos. The students also independently processed the texts of the lectures given by the teacher. Formation of practical abilities and skills was carried out thanks to ICT: training on simulators, use of virtual reality, and interactive learning methods. ICT was widely used during the current control and final assessment of acquired knowledge, skills, and abilities. The answers to the last question (Table 2), were justified by some respondents as follows:

Student 1: “During the pandemic, I was forced to stay at home all the time, which was difficult. I missed real-life communication with friends and acquaintances, and I wanted to visit cinemas, cafes, etc. During martial law, I had to leave my home and everything I needed for a full life and study. My friends also left and there is no connection with some of them. I worry about my life and the lives of my loved ones and friends”.

Student 2: “During the pandemic, I returned from the university dormitory to my parents. The Internet connection in the village is not of good quality, therefore, to receive educational materials, I had to walk 2 km to another part of the village, where the connection is better. And during the introduction of martial law, I also returned to my native village. Now, to study distance, I must walk along 2 km of a mined road”.

Student 3: “During the quarantine, I studied at home. My parents equipped me with a comfortable workplace with everything necessary for distance learning (a computer with a large high-quality screen, a webcam with a microphone, cable Internet with a speed of 100 Mbps, a comfortable table, and a chair). During martial law, I must leave my workplace and go down to the shelter, unequipped for studying”.

The study found that the mean square deviations from the average percentages of the same parameters, which were evaluated in different groups. Also, the between-group variance, which is a characteristic of the fluctuations of the considered groups, and the intragroup variance, which is a characteristic of the fluctuations, caused by random factors, not taken into account, are unequal values. This shows that the null hypothesis is false. Between-group variance is the weighted sum of squared deviations of group averages from the overall average, due to the heterogeneity of the sample, namely the different living and study conditions of the study participants, ranging from 283 to 971.

Discussion

Many countries around the world have experienced crises that have affected the education sector, related to natural disasters, wars, and epidemics: Germany (Delcker &

Ifenthaler, 2021), Croatia (Dautbasic & Becirovic, 2022), Afghanistan (Khlaif et al., 2021; Utsumi, 2022), Libya (Czerniewicz et al., 2019; Traxler et al., 2019) and Palestine (Traxler, 2018), Syria (Oliveira et al., 2021), Iraq, Yemen and North Africa (El-Senousy et al., 2021). This has negative and long-term consequences. As scientists have proved (Havari & Peracchi, 2019), children of people who experienced war and famine in childhood usually study less than children of those who had no such experience.

On average, if a mother experienced one year of war, her children would study 0.07 years less than children of mothers who did not witness war. And if she starved for one year, the children would study 0.49 years less. One of the explanations for this phenomenon is that parents, who were prevented from finishing school by the war, are unable to appreciate the importance of schooling in a person's life and encourage their children to study. Therefore, it can affect their children's education. At the same time, every year that a mother's education level increases, the duration of her children's education increases by an average of 0.25 year as well. Mothers' influence on the education of their daughters and sons is different (0.35 and 0.16 years, respectively).

About 50% of school facilities were damaged or destroyed because of wars in the Middle East and North Africa. At that time, refugee-hosting countries cannot provide them all with the appropriate level of education for many reasons (language barriers, lack of classrooms, stress, etc.). Under such conditions, an alternative may be the use of digital learning, provided by information technologies (El-Senousy et al., 2021; Swartz et al., 2018). The conducted research showed that the introduction of martial law in Ukraine affected the education sector, too. During the 2020 pandemic, more than 94% of students experienced changes in education (Reuter, 2020) – 93% of students studied fully remotely in the spring of 2020, compared to 35% blended and 75% face-to-face in 2019. In the spring of 2022, all Ukrainian educational institutions switched to distance education, except for military professional educational institutions, which continued blended learning (Serhiienko & Samoilova, 2022). As this study showed, pupils, students, and their teachers have a sufficient functional literacy level in using the computer and mobile devices.

This study showed, that 77% of the participants in the educational process were forced to change their place of residence but kept distance learning at the educational institution where they had been studying until February 24, 2022. The pandemic of 2020 made it possible to acquire the necessary competencies. The survey of 1,702 teachers from 950 educational institutions around the world showed that 71 percent of respondents noted an increase in the use of e-learning materials (Reuter, 2020). This study showed that 18% of respondents used

course materials from the world's leading universities with open access. 65% used ready-made videos of educational materials.

Also, 81% said that they wanted to use digital materials even after the end of the pandemic. 70% of teachers changed their teaching methods and 47% changed their teaching methods forever, and even after the pandemic, they will not return to the previous ones. The students, during the pandemic, learned to take responsibility for the results of their studies and acquired self-education skills. Thus, the 2020 pandemic has forever changed educators' and students' approaches to learning (Reuter, 2020). Scientists have found that after the pandemic, more than 62% of the participants in the educational process prefer a mixed form of education, 23% – distance, and 15% face-to-face, which is evidence of the impossibility and ineffectiveness of returning to face-to-face education (Bordoloi et al., 2021).

About 50% of respondents reported that the forced transition to distance learning helped them significantly improve their ICT skills (Bordoloi et al., 2021) and only 3% categorically disagree with it. However, despite the long period of forced distance training, 25% of teachers experience difficulties in organizing training, mediated ICT consider the workload to be excessive, and the effectiveness to be low. In addition, almost 50% complain about a big waste of time, spent on administrative work, which has increased during the pandemic (Dautbasic & Becirovic, 2022). This study found that about 53% were partially satisfied with the educational platforms they used during their studies, and 36% were delighted.

By this way, 47% of respondents support the effectiveness of a synchronous form of education (e.g., Zoom), 21% stand for using e-mail, and 13% advocate the use of Google Classroom and social networks (Bordoloi et al., 2021). According to surveys (Oliveira et al., 2021) conducted among 20 students and 10 teachers in Portugal and Brazil, it was confirmed that Zoom, Microsoft Teams, and Google Meet were most used for online communication. Moodle, Blackboard, Corujito were used for teaching. This study confirmed the demand for such platforms as Zoom (84%), Google Meet (31%), Google Classroom (67%), as well as mobile apps (79%), and social networks (29%), e-mail (43%). This study showed that the participants of the educational process used the following online learning tools: Blackboard (36%), Canvas (23%), Zoom (84%), Microsoft Teams (28%), Google Classroom (67%), Google Meet (31 %).

The working conditions of teachers in educational institutions changed during the occupation. As schoolteachers note (Traxler et al., 2019), the process of passing checkpoints that separate the place of residence and the place of work took a lot of time. For many teachers and students, attending school has become impossible due to its closure or destruction. Under

such conditions, the educational process was carried out online – through school websites, text messaging systems, phone calls, e-mails, social media, video recordings of the lessons, made by the teachers, or relevant YouTube or Google resources. Thus, technologies facilitated the process of interaction between students and teachers during emergencies. This study has practical benefits, as it allows planning and organizing of effective educational activities in extreme conditions, such as a pandemic or martial law.

Conclusions

During martial law, it is necessary to ensure the appropriate and safe living, learning, and working conditions for the population of the country. For this purpose, extreme distance learning with the use of information technologies has been introduced throughout the country. As this study showed, the subjects of educational activity had all the conditions for continuing their education during martial law in Ukraine. They had sufficient technological support although only a fourth of the respondents did not change their place of residence. In addition, the experience of distance learning during the 2020 pandemic allowed to obtain sufficient digital literacy, both for teachers to organize and ensure the educational process, and for their students to continue their education.

However, there are also some differences between studying during a pandemic and during martial law: difficulties in accessing the Internet, caused by the need to stay in shelters, or obstacles in overcoming distances, caused by danger and the conduct of hostilities. This study can be useful to scientists and educators, who are looking for effective learning strategies in extreme conditions to ensure the continuity of education. Future research should be directed to the search for optimal methods of teaching and assessment, which will allow achieving no lower academic results during online learning than during traditional learning.

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