ADAPTIVE STRATEGIES FOR EDUCATIONAL CONTINUITY: ASSESSING THE POTENTIAL OF HYBRID AND ASYNCHRONOUS LEARNING FORMATS FOR INCLUSIVE SETTINGS DURING WAR TIMES

ESTRATÉGIAS ADAPTATIVAS PARA A CONTINUIDADE EDUCACIONAL: AVALIAÇÃO DO POTENCIAL DOS FORMATOS DE APRENDIZAGEM HÍBRIDA E ASSÍNCRONA PARA CONTEXTOS INCLUSIVOS EM TEMPOS DE GUERRA

ESTRATEGIAS ADAPTATIVAS PARA LA CONTINUIDAD EDUCATIVA: EVALUACIÓN DEL POTENCIAL DE LOS FORMATOS DE APRENDIZAJE HÍBRIDO Y ASINCRÓNICO PARA ENTORNOS INCLUSIVOS DURANTE LA GUERRA

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ABSTRACT: This study aims to systematically examine the opportunities and limitations of inclusive remote learning under martial law, based on a synthesis of official data for 2022–2025. The methodology combines content analysis of reports by UNESCO, UNHCR, the World Bank, ITU, UNICEF, and the Ministry of Education and Science of Ukraine with comparative analysis, descriptive statistics, and indicator classification across four dimensions: accessibility, inclusion barriers, support measures, and adaptive strategies. The findings show diverse participation patterns of Ukrainian students in European education and significant territorial digital inequality, alongside large-scale damage to educational infrastructure. Key obstacles include air raid interruptions and power outages, while adaptive responses involve asynchronous learning, hybrid schedules, and underground classrooms. The study concludes that inclusive remote education is enabled by technological support and organizational flexibility, but long-term policy responses are required to address persistent inequalities and psychological strain.

KEYWORDS: Teacher at a general secondary education institution. Inclusive education. Distance learning. Martial law. Universal learning design.

RESUMO*: Este estudo tem como objetivo examinar sistematicamente as oportunidades e limitações da aprendizagem remota inclusiva sob lei marcial, com base em uma síntese de dados oficiais para o período de 2022 a 2025. A metodologia combina análise de conteúdo de relatórios da UNESCO, do ACNUR, do Banco Mundial, da UIT, do UNICEF e do Ministério da Educação e Ciência da Ucrânia com análise comparativa, estatística descritiva e classificação de indicadores em quatro dimensões: acessibilidade, barreiras à inclusão, medidas de apoio e estratégias adaptativas. Os resultados mostram padrões diversos de participação de estudantes ucranianos na educação europeia e significativa desigualdade digital territorial, juntamente com danos em larga escala à infraestrutura educacional. Os principais obstáculos incluem interrupções por alertas de ataque aéreo e quedas de energia, enquanto as respostas adaptativas envolvem aprendizagem assíncrona, cronogramas híbridos e salas de aula subterrâneas. O estudo conclui que a educação remota inclusiva é viabilizada pelo suporte tecnológico e pela flexibilidade organizacional, mas são necessárias respostas de políticas públicas de longo prazo para enfrentar desigualdades persistentes e a sobrecarga psicológica.*

PALAVRAS-CHAVE: *Professor de instituição de educação básica. Educação inclusiva. Ensino a distância. Lei marcial. Desenho universal para a aprendizagem.*

RESUMEN: *Este estudio tiene como objetivo examinar sistemáticamente las oportunidades y limitaciones del aprendizaje remoto inclusivo bajo ley marcial, con base en una síntesis de datos oficiales para el período 2022–2025. La metodología combina el análisis de contenido de informes de la UNESCO, ACNUR, el Banco Mundial, la UIT, UNICEF y el Ministerio de Educación y Ciencia de Ucrania con análisis comparativo, estadística descriptiva y clasificación de indicadores en cuatro dimensiones: accesibilidad, barreras a la inclusión, medidas de apoyo y estrategias adaptativas. Los resultados muestran patrones diversos de participación de estudiantes ucranianos en la educación europea y una significativa desigualdad digital territorial, junto con daños a gran escala en la infraestructura educativa. Los principales obstáculos incluyen interrupciones por alertas de ataques aéreos y cortes de energía, mientras que las respuestas adaptativas implican aprendizaje asincrónico, horarios híbridos y aulas subterráneas. El estudio concluye que la educación remota inclusiva es posible*

gracias al apoyo tecnológico y la flexibilidad organizativa, pero se requieren respuestas de política pública a largo plazo para abordar desigualdades persistentes y la carga psicológica.

PALABRAS CLAVE: *Docente de institución de educación secundaria general. Educación inclusiva. Educación a distancia. Ley marcial. Diseño universal para el aprendizaje.*

INTRODUCTION

The large-scale Russian aggression against Ukraine, which began in 2022, has led to an unprecedented humanitarian crisis that has affected all spheres of public life, including education. The Ministry of Education and Science of Ukraine (2024) states that the war has led to the massive destruction of educational institutions, the interruption of the continuity of the educational process, and the exacerbation of problems of access to quality education for millions of children.

Systematic rocket attacks on civilians, including schools and kindergartens, have turned educational institutions that were previously considered safe zones into targets for terrorist attacks. Forced migration of citizens, both national and international, has disrupted the usual educational regime of millions of students, jeopardizing the future of an entire generation of Ukrainian children.

UNICEF estimates that by the start of the 2024/2025 school year, approximately 4.6 million children in Ukraine were in the group at high risk of receiving education, as a consequence of the destruction of school buildings, lack of safe educational environments, psychological injuries and financial problems (UNICEF, 2025). This figure will include not only number children who fully deprived opportunities get formal education, but also those children, education which is not continuous or active and occurs in conditions that do not have none attitude towards quality education. Mass moving the population is still one difficult problem: by the end of 2024 in the country left approximately 3.6 million people, and over 6 million went to European countries (UNHCR, 2024a). A significant proportion of displaced persons are school-age children, and in this situation, continuity of education is very important not only for their cognitive development, but also for their psychosocial adaptation to the traumatic experiences of war.

One of the most pressing issues is the security of the schools. According to information provided by Human Rights Watch, from February 2022 to October 2023 was recorded over 3000 cases of destruction of educational institutions, of which 365 were fully destroyed (Buchanan et al., 2023). Not only attacks on schools deprive children of physical space for learning, but also an atmosphere of fear and uncertainty that kills motivation to study, and the idea of a stable educational process. Teachers are forced to work under pressure, but they are charged with responsibility for ensuring security for students in case of air alarms, evacuating them to shelters, as well as granting psychological support to children who suffered terrible war events. Direct learning is impossible or very limited in most regions of Ukraine, especially in

the regions that are on the front lines, as well as in regions that are often exposed to rocket shelling that forces the education system to search for other ways of providing a continuous educational process.

In this context, distance and blended teaching has evolved from an experimental practice into a serious mechanism for survival of educational systems. Although before the COVID-19 pandemic online learning was considered in addition to full-time studies, since then, it became the main or the only form of education for a large number of students in war conditions. Platforms remote teaching allow schools to continue teaching students even in cases where they do not have physical access to the school buildings. It also provides flexibility to families who were forced to move to other regions or abroad, and minimizes danger to life and health of students and teachers in areas of active conflict. At the same time, transition to remote learning forms of teaching creates additional pressure for inclusivity in the educational process, because the quality of online education depends on the access to digital equipment and stable internet connection, availability of electricity and digital skills of both students and teachers.

Despite the fact that remote teaching plays an important role in wartime, does not exist empirical research that would contain systematic analysis opportunities and limitations inclusive online learning in the Ukranian context. Modern literature usually considers a fragment of the problems, such as technological support, psychological welfare students or adaptation teachers to distance learning education, but does not cover all aspects that determine inclusivity to remote education.

In this article, we will be systematically reviewing opportunities for inclusive remote learning in conditions of martial law, based on a broad review of official statistics for the 2022–2025 period. Research aims to consider the most important factors that contribute or hinder inclusiveness of online education in war conditions, such as forms of involving students to formal education, the level of destruction of infrastructure, the impact of moving population, the supply of digital equipment, the opportunity of continuity training, and the geographical differences in digital opportunities. Research results should be taken into account in the educational politics and international programs that contribute to education in humanitarian crisis conditions in Ukraine, as well as be used to create more effective measures that can support sustainability and inclusiveness education in extreme conditions.

LITERATURE REVIEW

International research from 2020 to 2025 confirms that remote and hybrid formats hold continuity training during war, but they put forward elevated requirements for inclusiveness, coordination and psychological support of students, including those with special needs. Interdepartmental data under the auspices of UNESCO was recorded in 2024 in Europe, in face of the spread of "double" trajectories of Ukrainian children: part studying only in schools of countries where they are staying, part combining them with Ukrainian online education (UNESCO, 2025a). UNHCR surveys detail the structure of access barriers and the dynamics involved in formal education in countries that are receiving Ukrainians, emphasizing the need for flexible remote decisions and interdepartmental coordination (UNHCR, 2025).

Real empirical research confirms these trends. So, Parmigiani et al. (2023) on basis analysis of Italian experience prove that effective inclusion of Ukrainian refugee students is possible by conditions of differentiated approach, language support and digital tools training. Similarly, Londar et al. (2025) generalized Ukrainian experience with education software stability under war times, showing that combining remote platforms and pedagogical innovations supports the continuity of teaching even by partial destruction of infrastructure.

In the national context, institutional response is outlined through programs of reconstruction and modernization, such as the World Bank Education Initiative (2025a), that combines the improvement of safety, textbooks, transportation for vulnerable students and the training teachers, keeping remote trajectories where the "eye of the teacher" is impossible. At the same time, analytics from Wergeland Center shows the scale of destruction of educational institutions education and justifies long-term coexistence, defending blended and distance learning formats (The European Wergeland Centre, 2024). European Policy Reviews advocates for digital transformation education as strategic for Ukraine concerning inclusion and sustainability (Eurydice, 2025).

Research by Nadyukova and Frenzel (2025) reveals psychological measurement regarding digital adaptation, showing how Ukrainian teachers cope from stress and, at the same time, support hybrid models of learning. As shown by Letzel-Alt and Pozas (2024), they use differentiated approaches and digital tools in mixed formats, which allows teachers a more efficient support for Ukrainian refugee students, promoting inclusiveness and reducing educational barriers.

A critical layer of research concerns Universal Design for Learning (UDL) as a basic framework for inclusive education in online courses. Systematic review and meta-analysis at

Cogent Education show significant statistics on outcomes and engagement applicants (Almeqdad et al., 2023). Some systematic reviews confirm that tools accessibility—subtitles, transcripts, voiceover, high contrast, and keyboard navigation—downgrade barriers for applicants with disabilities and at the same time improve the experience of all students in a digital environment (Yang et al., 2024). Generalization in the International Journal of Educational Technology in Higher Education demonstrates that course design with accessibility principles and UDL is key to inclusive online interaction and assessment (Lomellini et al., 2025). Additional SLRs in IJLTER emphasize evidence-based UDL practices to support students with disabilities in online education (Utami et al., 2025).

In parallel, a body of work on organizational models training is focused on crisis conditions. A systematic review of ERT in K–12 shows efficiency in asynchronous trajectories, offline packages and flexible schedule for unstable connection (Al Mazrooei et al., 2023). Current journalistic and analytical messages illustrate the adaptation of schedules and facilities (including underground or shelter) as part of safe hybrid models (Arhirova, 2025).

An important part of the inclusiveness process are auxiliary technologies. Systematic Reviews in Frontiers in Education and meta-analytic works in leading journals that have positive records of influence regarding digital AT interventions for engagement and well-being of students with disabilities, in particular pointing to the potential of AR solutions (Mukhtarkyzy et al., 2025). Additional SLRs confirm the growth of AT roles and of barriers implementations (Fernández-Batanero et al., 2022).

Policy Framework for digital equality in education is presented in OECD reports: countries are recommended to combine resource provision, standards to accessibility, competence development and data for management decisions; reports also emphasize the request for further training of teachers (OECD, 2023). European reviews highlighted the integration of inclusive principles in digital ecosystems education (Eurydice, 2025).

In general, the world literature of the last five years agreed with the thesis: inclusivity on remote education increases when four components are combined—guaranteed access (devices and connectivity), UDL-oriented design and technical content availability, preparation of teachers, as well as polities for digital inclusion with monitoring results. At the same time, there remains a need for broader standardization accessibility requirements, state platforms, regionally sensitive mechanisms, subsidization connection and system assembly data on inclusive real-time results (OECD, 2024).

MATERIALS AND METHODS

Research was performed as analytical-synthetic generalization based on secondary official data for the period 2022–2025 without involvement surveys and simulated arrays. The material is formed from public reports and databases international organizations: UNESCO, UNHCR, World Bank, ITU, UNICEF, reviews of policies from European commissions and Eurydice networks, as well as national sources from Ministries of Education and Science of Ukraine, UNDP and analytical generalizations VoxUkraine and UA-Energy/DiXi Group. Sources from Russian or Belarusian jurisdictions were not used.

Selection data was carried out according to clear criteria. We considered official status and publicity of access, availability description methodologies collection, regularity updates, possibility independent verification, consistency hourly slices from framework 2022–2025. For each indicator the date of observation and the primary source that provides reproducibility.

Object measurement covers six groups of indicators. The first group describes the modalities of participation of Ukrainian students in formal education in European countries. The second group reflects the scale of damage and destruction of education institutions and cost recovery. The third group is focused on the volume of internal and external moving population. The fourth group characterizes software devices and the coverage of training of teachers. The fifth group concerns the conditions of continuity training considering air alarms and planned outages of electricity. The sixth group concerns digital capabilities for remote training at national and regional levels and includes shared households from fixed internet and the number of fixed and mobile broadband subscriptions per hundred residents.

Processing data was carried out in several steps. Once the unification terms and units measurement are done, it requires the harmonization of observed periods, the verification of consistency between the sources, calculation fractions and averages values, according to the primary sources.

Methodological toolkit includes at least ten known approaches from allocation to priority. Content analysis was used to analyze official documents; comparative analysis between countries and regions was made, organizing trends, describing statistics, structuring indicators, synthesizing generalization, mapping interested parties, analyzing policies and energy supply, as well as making verifications of the sources. Two approaches were developed, a theoretical and procedural one. The first is universal design for learning as an assessment framework, ensuring accessibility of educational content and tools interactions in the digital environment. The second is the comparative institutional analysis concerning hybrid

organizational models with description of synchronous and asynchronous mode scenarios, offline packages and transition protocols during alarms and outages.

RESULTS

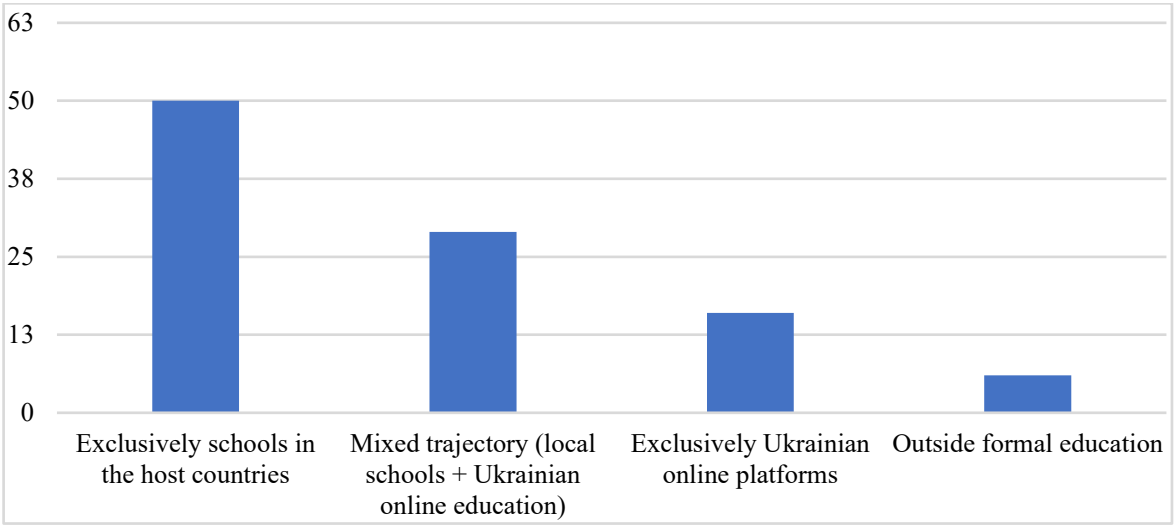
Accessibility of distance learning: modalities and digital capability

Mass migration of the Ukrainian population to other European countries led to unprecedented situations in education systems that had to ensure access to education for millions of refugee children. It is estimated, according to the Regional UN information center, that as of July 2024, over six millions of Ukrainians applied for asylum in European countries (UNRIC, 2024). Some of them are children of school age, whose educational capabilities have become key to cognitive development, as well as for psychosocial adaptation to the traumatic conditions of war. In this context, inclusivity of remote teaching is significant to the extent degree of abilities required by different categories of students, regardless of places their place of stay, socio-economic status of their families and availability of digital infrastructure for participation in the educational process.

Research shows that there exist four main models of participation in formal education, which reflect different approaches for refugee families to integrate into host countries' communities, as well as for preservation of their connections with the Ukrainian education system (Figure 1). Half of children are the largest group, which consists of children who are studying only in the receiving countries, without further participation in Ukrainian education.

This model reflects intentions of full integration into the new environment and assimilation in language and culture host society. At the same time almost a third of students choose a combined path, studying in local schools but attending Ukrainian online courses. In this way, they can save connection with Ukrainian language, culture, and educational standards, which may be important for families who want to return to the country after wars or save the cultural identity of their own children.

Figure 1.
Distribution of Ukrainian students by study modality in Europe (2024–2025 academic year)



Note. UNESCO (2025a).

The distribution of forms of learning shows that about half of European Ukrainian children use remote or mixed learning, that means that online learning has importance for achievement inclusiveness.

A significant part of these students (16 % from general number) do not visit official schools in the country of stay, using only Ukrainian remote courses. This form of learning may be due to a number of reasons: linguistic barriers that complicate adaptation in local schools; the idea of a soon return to Ukraine; impossibility to access local schools due to bureaucracy or overcrowding host communities; and conscious unpreparedness families that violate Ukrainian school system. Remote training is not an alternative for this group of children, but the only opportunity to provide their formal education, so inclusion of Ukrainian online platforms is particularly important.

There is a special interest in a group of children who do not belong to any official educational programs—6% of general Ukrainian students in Europe. This category is the most important obstacle to inclusion, as the reasons for their impossibilities to get education are numerous and can intersect: they do not have access to documents about the previous education, do not have easy access to information about opportunities of receiving education in the country of stay, psychological influence by the war and displacement feelings forces them not to attend school; their families can allow itself only to work, not to study, and their parents don't have sufficient digital knowledge to engage in remote learning. Inclusive formats of remote learning that are based on flexible graphs, psychological support, language adaptation and low technological requirements, is the key to restoring access to this group to formal education.

Remote teaching is significant to the group that depends on the availability of a stable Internet, and in this case exists a high level of territorial differentiation between European countries, as well as internal territorial differentiation in Ukraine. In the case of Ukrainian children who did not have opportunities to leave the country, intensity of digital opportunities in the region directly determines ability to access high-quality online education (Table 1). The level of stationary Internet penetration in households is 62%, which means that approximately 40% of households use only mobile internet or don't have a stationary connection at all (ITU, 2025). The level of penetration of mobile broadband is higher, 81.6 percent, but it has significant shortcomings in the plan of stability connection, speed transmission data and cost of traffic, which makes it unsuitable for long-term video conferencing, as well as for downloading large volumes of educational materials.

Table 1.
Broadband access indicators of Internet in Ukraine: national and regional data (as of December 2023)

Indicator	Meaning
Households with fixed Internet (per 100 households), average for Ukraine	62
Fixed broadband subscriptions (per 100 inhabitants) – Kyiv region	101
Fixed broadband subscriptions (per 100 inhabitants) – city of Kyiv	92
Fixed broadband subscriptions (per 100 inhabitants) – Lviv region	77
Fixed broadband subscriptions (per 100 inhabitants) – Odessa region	63
Active mobile broadband subscriptions (per 100 inhabitants), Ukraine	81,6

Note. ITU (2025).

Regional differentiation reflects a high level of digital inequalities that directly affects inclusivity in remote study: students in Kyiv areas have almost double greater access to stable the internet than students in Odessa areas.

Local comparison differences between regions Ukraine by level digital the possibilities are striking. The highest indicators observed in the capital region: Kyiv region – 101 fixed line connections broadband internet per 100 inhabitants, city of Kyiv – 92. Such indicators that exceed 100% in Kyiv areas are explained by the presence of several subscriptions in households and businesses relations. The Lviv region with 77 subscriptions occupies an intermediate place that individually reflects the developed digital infrastructure of the regional center. 63

subscriptions in Odessa areas are the lowest among studied areas that can explain the bigger quantity of rural population and worse broadband Internet in the suburbs.

It means that inclusiveness of remote teaching directly affects this territorial inequality. Kyiv and Lyiv region have significant advantage in terms of stability connection, speed internet and opportunities simultaneous involvement several members families to online activities. Parents can work remotely, older children can participate in synchronous online classes, and younger children can perform interactive tasks on educational platforms, and all that simultaneously, without overloading the home network.

And vice versa, in areas where fixed Internet connection is worse, such as Odessa region, significant fraction students are forced to use mobile connection or doesn't have at all stable connection that makes impossible synchronous remote training and limits them in working with multimedia content.

Complex analysis accessibility remote teaching shows that there are three main groups of students who have different opportunities. Children who have stable broadband connection in family and personal digital devices, can fully participate in synchronous online lessons, download big educational resources and use interactive educational platforms. The second group uses mobile Internet or unstable stationary connection that restricts their using asynchronous formats and text materials that contain multimedia elements. The third group is composed of children who do not have access to reliable internet or own devices, which practically eliminates them from remote education and makes them dependent on offline tasks or points of open access, which are not always available in rural or remote areas.

Barriers for inclusion: destruction, displacement, interruption of learning

Switching to remote teaching during the war is usually considered a universal decision that guarantees continuity education, although actually the format of the training undergoes different structural restrictions that restrict its inclusive nature. In a state of war, remote training is a necessity, unlike from peacetime, when it is consciously a choice for millions of students who no longer have access to safe school premises. Such limitation is distributed unevenly: most vulnerable in groups of population that are displaced persons, children from low and middle income level families, students in areas with low level digital infrastructure, as well as individuals who live on the front lines or in areas regularly exposed to rocket shelling.

Mass damage to educational infrastructure turned out to be one of the most critical problems in ensuring inclusive education in Ukraine (Table 2). The fourth wave of Rapid

Damage and Needs Assessment conducted by the World Bank, shows that by 2025, 3.373 educational institutions will be damaged at all levels, 385 of which will be fully destroyed (World Bank, 2025b). These statistical data relate not only to physical loss of buildings, but also to safe educational environments where children could communicate, have access to school resources, libraries, computer classes, as well as support teachers. Restoration of educational infrastructure is estimated to cost US $13.4 billion, which again significantly exceeds possibilities of the state budget in war conditions, but prospects for ambulance reconstruction is at its best case, unrealistic even in the medium term perspective.

Table 2.
Scale of destruction of educational infrastructure and impact on accessibility of remote training (as of 2025)

Indicator	Meaning	Impact on the inclusiveness of distance learning
Damaged educational institutions (all levels)	3 373	Loss of access to school computer labs and Wi-Fi
Educational institutions completely destroyed	385	Complete dependence on home internet and devices
Estimated cost of restoration	$13.4 billion	Long-term coexistence of remote formats (years)

Note. World Bank (2025b).

Destroyed schools force students to rely exclusively on their own homes (digital infrastructure), which strengthens existing disagreements between children of different socio-economic groups.

Destruction of schools has a double negative impact on provision inclusiveness remote learning. First, children lose access to digital infrastructure schools, lacking compensation for the compensated absence of similar tools at home, such as computer classes, free Wi-Fi, printers and scanners. Students from low-income families who do not have their own laptops or tablets, could borrow school equipment to or after classes. Now they are completely dependent on domestic resources that are usually unavailable. Secondly, the destruction of schools means that physical space that used to support children with special needs, providing them individual counseling, social and emotional support, cannot be completely provided in remote format.

There is another obstacle to inclusivity in remote learning, caused by forced displacement. As it was stated in the introduction, about three to six million people are still internally displaced persons in Ukraine, and many of them are families with children of school age. Alienation interferes with constant access to digital infrastructure in different ways. The

process of evacuating families from the front lines often leads to the fact that computer equipment remains at home, because families have little space for its transportation or it can be destroyed in the event of bombing. They also are in new temporary places of accommodation, and this means that they have to install new Internet connection that takes time, they have to present documents in a new location of accommodation and spend money to purchase services that the majority displaced has no families.

Children who were displaced within countries, usually are at their worst position because they live in temporary accommodation, where there is no individual space for learning, stable internet connection or opportunities to focus on learning due to overcrowding. According to UNHCR, hundreds of thousands of children of school age do not attend school, and a significant number of them are internally displaced persons and refugees who were unable to integrate into new systems education (UNHCR, 2024b). Distance learning education was not the solution for these groups, and without special efforts technological and socio-economic barriers turned out irresistible.

Systematic interruptions in the process training through air raid sirens alarms and shutdowns electricity seriously interfere with efficient remote teaching even those students who have access to devices and Internet (Table 3). Analysis of data for the first half of the 2024/2025 academic year showed that the average time spent on one alarm on a weekday during the school day was thirty-three minutes (Savisko & Karakai, 2025). Although it can be considered insignificant during the period of time, in the days when there were many notifications, the amount of teaching time in some areas was up to 100 lessons per month. Such systematic interruptions made it impossible to carry out full-fledged synchronous online classes, because teachers were forced to constantly interrupt educational processes, and students lost concentration and the ability to switch to another level understanding complex concepts.

Table 3.

Interruptions educational process: air alarms and shutdowns electricity (2024–2025)

Indicator	Meaning	Impact on the inclusiveness of distance learning
Median duration of a single air raid alert on weekdays (8:00 a.m.–3:00 p.m.)	33 min	Interruption of synchronous online lessons
Maximum possible loss of lessons per month (on days with multiple alarms)	up to 100 lessons	Inability to complete the training program
Total duration of planned power outages for the population	1,951 hours	Exclusion of students without backup power sources

Note. Savisko and Karakai (2025); Posternak (2025).

Periodic disruptions related to unrest and power outages exacerbate the situation in education: children whose families have generators or batteries can continue their education, while others are unable to participate in the educational process.

Another pressing burden that challenges the inclusiveness of distance learning is the energy crisis. In 2024, planned power outages for the population amounted to nearly two thousand hours, exceeding eighty days of complete power outages (Posternak, 2025). Although the power outage schedules did not necessarily coincide with school hours and varied across regions, they had a major impact on the ability of all categories of students, especially those without other sources of electricity, to participate in distance learning. Power outages meant not only the inability to turn on a computer or tablet, but also the absence of home Wi-Fi routers, instability of mobile internet connections due to the closure of operators' base stations, and the inability to charge devices for further use.

A broader view of these obstacles means that they disproportionately affect the most vulnerable groups of students. Internally displaced children face multiple challenges simultaneously: lack of stable housing, insufficient access to devices and the internet, psychological trauma associated with displacement, and the need to adapt to new social circumstances. Children from low-income families are particularly vulnerable to power outages, as their parents cannot afford generators, backup batteries, or expensive mobile internet packages with high data speeds. In areas with low digital infrastructure, as noted in the previous section, students have limited access to stable broadband internet when electricity is available. In frontline areas, children are most often victims of air raid sirens and are most at risk, making synchronous distance learning virtually impossible.

This has a cumulative impact on distance learning, as distance learning, which was supposed to be a universal solution for all students, ultimately only reproduces and exacerbates existing disparities in education. Children from wealthy families living in large cities with well-developed digital infrastructure have the opportunity to receive a quality education even during wartime, while children from vulnerable groups are virtually excluded from the educational process due to technological, economic, geographical, and security factors.

Inclusiveness support measures: provision and training

In order to remove the identified barriers to the inclusiveness of distance learning, the Ukrainian education system, with the help of international partners, has presented a set of

specially designed measures aimed at overcoming all technological, infrastructural, and pedagogical barriers to the involvement of vulnerable groups of students in the educational process. These measures are not limited to the supply of equipment, but also include the systematic training of teaching staff, the creation of safe learning environments, and the development of a strategic model for the digital transformation of education.

The comprehensive approach of these measures is that they are aimed at meeting the needs of the most vulnerable groups of students, namely children from low-income families, internally displaced persons, students with special educational needs, and students in areas with underdeveloped digital infrastructure.

Providing teachers and students with digital equipment is now a priority for increasing the inclusiveness of distance learning (Table 4). To promote the continuation of education in Ukraine, the UNESCO Global Coalition on Education was established to help organize the delivery of more than 50,000 digital devices to teachers and more than 8,500 students in 2023–2024 (UNESCO, 2024). Since the ability of teachers to conduct quality online classes is a prerequisite for the inclusiveness of the entire system, they were given priority.

Teachers received laptops and tablets with software installed that allows them to conduct video conferences, develop interactive learning tools, and assist in communicating with students. Assistance was provided to students belonging to the most vulnerable groups: children from low-income families, internally displaced persons, and students with special educational needs who did not have their own devices, which made it completely impossible for them to participate in distance learning.

Table 4.
Digital support and professional development of teachers (2023–2025)

Indicator	Meaning	Impact on inclusiveness
Digital devices provided to teachers (units)	> 50 000	Enhancing the capacity to deliver high-quality online classes
Digital devices provided to students (units)	> 8 500	Ensuring access to distance learning for vulnerable groups
Teachers and specialists covered by training on safety and inclusive practices (persons)	> 7 400	Improving the quality of inclusive online teaching

Note. UNESCO (2024).

Inclusive distance learning relies on digital equipment and teacher training, which are material and methodological prerequisites for this process, but its coverage is insufficient for all teachers and vulnerable students.

Teacher professional development cannot be less important for inclusiveness, as access to equipment does not always ensure its effective implementation to meet the educational needs of different students. More than 7,400 teachers and education specialists have received specialized training on safety, psychological support for students, inclusive work, and the use of digital tools in the educational process (UNESCO, 2024).

These trainings focused not only on the technical aspects of working with online tools, but also on ways to modify teaching materials to meet the needs of students with different levels of digital literacy, practices that take into account traumatic experiences to meet the needs of children who have survived war, and ways to maintain motivation in a distance learning environment.

At the same time, the coverage of the training is not wide: according to the Ministry of Education and Science of Ukraine (2025), the total number of teachers in the system exceeds 400,000, so only about 2% of them have received specialized training to work in wartime conditions, as well as in inclusive distance learning practices.

Investments in physical infrastructure that supports hybrid learning formats and allows for face-to-face communication even in conditions of military danger were made alongside the provision of digital support (Table 5). The Ministry of Education and Science of Ukraine (2025) has also developed a strategy to build 119 more shelters in educational institutions by 2025, which will facilitate face-to-face learning in areas where air raid alerts are frequently declared. Inclusiveness depends to a large extent on the availability of safe space, as certain groups of

students, especially younger schoolchildren and children with special educational needs, require direct contact with teachers and peers for effective learning.

Table 5.
Infrastructure support for safe and accessible learning (2024–2025)

Indicator	Meaning	Impact on inclusiveness
Additional shelters at educational institutions, planned for construction	119 objects	Opportunity for face-to-face interaction for students with special educational needs and younger grades
School buses planned for purchase	≈ 600 units	Ensuring transport accessibility in rural areas

Note. Ministry of Education and Science of Ukraine (2025).

Ensuring safe infrastructure and transportation creates conditions for hybrid learning formats, which are the most convenient solution for students with different needs.

The purchase of approximately 600 school buses will be used to address the issue of access to education in terms of transportation, which is particularly acute in rural and remote areas. In some areas, for example, where small schools are closing or falling into disrepair, the distance to the nearest functioning school has become even greater for many children. Formal transportation reduces the cost of access to hybrid forms of learning, where children can combine face-to-face consultations, group work, and socialization with distance learning for part of the curriculum. For students with special educational needs, special transportation is a prerequisite for participation in any face-to-face educational activity.

Educational resilience is supported at the systemic level through broad international initiatives, including the World Bank's LEARN programs, which provide a range of measures to improve school safety, supply textbooks, provide transportation subsidies for at-risk students, and train teachers (World Bank, 2025a). A distinctive feature of this program is its comprehensive approach, based on an understanding of the interdependence of all elements of inclusiveness: it is not enough to simply supply devices if teachers do not understand how to use them effectively; it is not enough to simply train teachers if students do not have access to stable internet. The LEARN program clearly supports distance learning where face-to-face learning is not feasible (as it is known that hybrid models will be an integral part of Ukrainian education until the post-conflict phase).

The digital transformation of education, as formulated in European policy reviews on the digital transformation of the education sector, defines inclusiveness as one of the elements of sustainable development of the education system (Eurydice, 2025). In the case of Ukraine,

digitalization is not just technological modernization, but a strategic course that will ensure the continuity of education during a long-term crisis. An inclusive digital ecosystem involves not only infrastructure development, but also the implementation of recommendations on content accessibility, staff training, and methodological analysis of the learning outcomes of different categories of students in order to identify and remove barriers to participation in a timely manner.

Adaptive strategies for inclusive distance learning

To address various challenges related to the state of war, the Ukrainian education system has developed several adaptive strategies to the traditional concept of distance learning, which refers to the notion of distance learning as a single synchronous online learning experience. Such innovations were the result of the need to ensure continuity of learning in the face of systematic air raid alerts, power outages, limited access to digital infrastructure, and diverse student needs. The universal value of these plans is that they can adapt to uncertain situations and continue to be involved in learning even in cases where a child cannot use standard forms of online education for technological, economic, or security reasons.

A key adaptive approach was the introduction of a multi-level system of learning formats, allowing for quick transitions between them depending on the circumstances (Table 6). Unstable power supply in the regions has made asynchronous learning materials an extremely important tool, as students can download them in advance and study at their own pace when electricity is available. Teachers prepare 15-20-minute video lessons, interactive self-assessment tasks, and text materials that can be downloaded without a constant internet connection. This approach will reduce dependence on synchronous online classes and allow families to organize the learning process taking into account times when the power may be cut off, which is especially important when the family does not have alternative sources of electricity and its income is not high.

Table 6.

Adaptive strategies for inclusive distance learning in wartime

Strategy	Target group	The mechanism of inclusiveness
Asynchronous learning materials (videos, interactive tasks)	Students in regions with unstable electricity supply	The ability to study at any time when electricity is available

Offline task packages (printed materials, USB drives)	Children without permanent access to the Internet, rural areas	Complete independence from network connection
Hybrid layouts with quick switching between formats	All students, especially those in frontline areas	Continuity of education regardless of the security situation
Underground classrooms and shelters with educational equipment	Children with SEN, younger schoolchildren	Maintaining eye contact with teachers and peers

Note. Arhirova (2025); UNESCO (2025b).

Multi-level adaptive tactics create pathways to continuous education, where all children have access to at least one type of learning regardless of their circumstances.

Offline task packs have already become the most comprehensive solution for students who are completely deprived of stable access to the Internet or digital technologies. These packages contain printed learning materials, self-study assignments with comprehensive instructions, and a USB drive with video lectures and other interactive materials that can be accessed on any computer without an internet connection. Such packages will be particularly relevant for children living in remote rural areas where there is no mobile Internet, as well as for internally displaced persons living in temporary accommodation. Teachers distribute these packages using school buses, community centers, or post offices so that even children in the most remote areas can access educational materials.

Hybrid schedules, which allow for easy transition from face-to-face to distance learning, have become the standard for schools in areas where air raid alerts are frequently declared. Education systems are designing their curricula in such a way that learning can take place in different formats without compromising content. For example, new and complex concepts are taught in face-to-face classes, where there is an opportunity to interact and ask questions directly, while reinforcement of the material and practical tasks are transferred to distance or asynchronous learning. This is especially important for students with special educational needs who require an individual learning pace and the ability to review information.

The most striking example of this idea in action is the creation of underground classrooms in schools in regions that are frequently subjected to rocket attacks. Journalists report that children are starting the new school year in specially prepared underground rooms equipped with desks, blackboards, lighting, and limited ventilation (Arhirova, 2025). Although these are not ideal conditions for learning, they still provide a valuable and important opportunity for younger students and children with special educational needs to be in direct

contact with teachers and classmates. According to documents provided by UNESCO, safe learning environments, such as underground shelters equipped with learning resources, have become one of the key elements of measures aimed at ensuring the safety and sustainability of schools in conflict regions (UNESCO, 2025b).

In the case of children with special educational needs, underground classrooms can be particularly valuable, as many of them require tactile interaction, special devices, and direct assistance from teaching assistants, which is not always possible in a fully remote learning environment. The ability to conduct face-to-face classes, at least in a small format and under difficult conditions, will enable teachers to provide individual consultations, adapt teaching materials to specific needs, and promote the social and emotional development of such children.

By combining these adaptive strategies, a multi-level system of inclusivity will be created with a range of access points to education available to every child. Students with a stable internet connection can attend classes conducted synchronously online, students with an unreliable internet connection use asynchronous material, children who do not have any digital resources receive offline packages, and students whose lives depend on personal interaction attend underground classes. This is a direct response to the numerous obstacles identified in the previous sections and is an indication that the education system can respond to extreme circumstances while adhering to the concept of inclusiveness.

DISCUSSION

The possibilities of inclusive distance learning in wartime

The study found that distance learning in a state of martial law performs various integrative functions that go beyond face-to-face learning. An analysis of four forms of Ukrainian children's involvement in European education shows that distance learning platforms provide displaced persons with flexibility in obtaining education, as they can study regardless of their place of residence. Of particular interest is the ambiguous course of 29% of refugee students: they are integrated into local schools and at the same time connected to Ukrainian education through online platforms.

This observation is consistent with the findings of Londar et al. (2025), who showed that combining distance learning platforms and pedagogical innovations can promote continuity of learning even in situations where part of the infrastructure has been destroyed. Continuing their analysis in our study demonstrates that the inclusive value of distance learning is based

not only on access but also on creating opportunities for the cultural and educational identity of children outside Ukraine.

The strategies that have been recognized include asynchronous learning materials, offline task packs, hybrid schedules, and underground classrooms, and show how the education system can create alternative pathways to learning. Asynchronous formats have become a universal solution to the problem faced by students in areas where electricity supply is unstable, allowing students to study whenever electricity is available and download any materials in advance.

This is consistent with the findings of a systematic review of the effectiveness of asynchronous trajectories and flexible schedules in ensuring unstable connectivity during distance learning in emergency situations (Al Mazrooei et al., 2023). At the same time, our analysis showed that in specific military conditions, asynchrony is not only a pedagogical solution but also an indispensable response to systematic interruptions caused by air raid sirens and planned power outages.

The fact that the scale of digital provision is over fifty thousand devices for teachers and over eight and a half thousand for students confirms that the institution has identified access to technology as a necessary condition for inclusiveness. However, when these figures are compared with the number of teachers (over four hundred thousand), it is clear that there is a large gap between needs and available resources. This is consistent with the findings of Londar et al. (2025), according to which inclusivity requires the provision of technology as a condition that is, however, not sufficient. Our study complements this analysis with factual data on how teachers should be trained simultaneously: 7,400 teachers have been trained in inclusive practices, which is only 2% of the total number of teachers. This discrepancy between the amount of digital equipment and professional development is an indicator of the threat of wasteful use of equipment due to the lack of methodological training for teachers.

Limitations of inclusivity: remaining challenges

Although the opportunities are clear, the results of the study confirm that there are structural barriers that hinder the inclusive potential of distance learning. The most significant problem is the aforementioned territorial digital divide: 100 fixed broadband subscriptions per 100 inhabitants in the Kyiv region versus 63 in the Odesa region. This almost twofold difference means that children who need equal educational opportunities actually have different basic opportunities for quality distance learning depending on the region in which they live. Other

obstacles to overcoming digital inequality include the destruction of 3,373 educational institutions, which deprives children of access to school computer classrooms and free Wi-Fi: systematic interruptions due to air raid sirens, with an average duration of 33 minutes, and power outages, with a total duration of 1,951 hours in 2024.

The group of children who do not attend school, which accounts for 6% of Ukrainian refugees in Europe and, according to UNHCR (2024c) estimates, hundreds of thousands, points to a serious limitation of distance learning: it does not cover the most vulnerable groups, for whom there are numerous and intersecting barriers. This finding is consistent with the Profession of New Education (2023) analysis of educational losses due to war, which indicates that technological solutions cannot compensate for socio-economic, psychological, and administrative barriers. In our study, we identify the following general findings: children from low-income families, internally displaced persons, and students in areas with low digital infrastructure face a number of complementary barriers simultaneously.

The psychological aspect of inclusivity constraints is explored in Nadyukova and Frenzel (2025) study on Ukrainian teachers' stress and coping mechanisms during the war. Although this has not been studied at the psychological level, the level of teacher training (only 2% attended specialized training) indicates a lack of systematic support for teachers, who are forced to cope with their own stress and the trauma of their students remotely. According to Nadyukova and Frenzel (2025), online teaching requires not only technical training for teachers, but also psychological support and methods that take traumatic experiences into account. This conclusion is confirmed by our results and reveals a discrepancy between the scale of the problem (over 400,000 teachers) and the number of providers (7,400 who have undergone training).

A long-term problem of inclusivity is the accumulation of educational losses due to regular interruptions in the learning process. The figures mentioned, starting with 100 missed lessons per month on days with multiple air raid alerts, mean that even high-quality distance learning platforms cannot ensure that the entire curriculum is covered. Profession of New Education (2023) assesses such losses as a danger to an entire generation, and our study offers empirical evidence of this with clear quantitative parameters for interruptions. To some extent, these losses can be overcome with asynchronous formats and offline packages, but they cannot replace a structured learning process, especially among younger students and children with special educational needs.

Recommendations for inclusive policy

Based on the identified opportunities and limitations, several policy options can be developed that apply to emergency response. First, there is territorial digital inequality, which requires specific investments in the development of broadband networks in areas with the lowest Internet penetration rates. The OECD Digital Education Outlook (2023) report proposes integrating resource provision and accessibility criteria with skills acquisition, which is highly relevant for Ukraine. These recommendations are specified in our study, which states that priority should be given to regions where there are fewer than 65 fixed subscriptions per 100 people, as it is in these regions that the difference in access to quality distance learning is most significant.

Second, there is a need to implement internet subsidy programs for vulnerable populations, such as low-income families, internally displaced persons, and large families. Economic barriers to stable internet access partly explain the number of children who do not attend school (6%). According to OECD data (2023), meaningful digital inclusion must go beyond technological access to digital devices and also include the economic ability of households to pay for communication services. Subsidies are an essential control measure in wartime, when a significant portion of the population has lost income due to displacement or the destruction of businesses.

Third, education policy should focus on teacher training. This is not enough to change the system, as only 2% of teachers receive specialized training in inclusive distance learning practices. According to the OECD Education Policy Outlook (2024) forecast, digital competencies and inclusive practices should be included in initial teacher training and mandatory professional development programs. We confirm this proposal by showing that there is no correlation between the amount of digital equipment (50,000 devices) and methodological training on the successful use of equipment (7,400 training sessions).

Fourth, universal design of learning standards across all public education platforms can significantly increase the inclusiveness of distance learning. As the literature review shows, UDL-based content design minimizes barriers for learners with special educational needs and improves the experience for all users. Among the tools that the OECD (2023) proposes to promote inclusiveness, the standardization of accessibility specifications for open platforms should be mentioned. Our research has found that there are many adaptive strategies (asynchronous materials, offline packages, hybrid schedules) that can be codified into a set of standards for the creation of digital educational content.

Fifth, the conditions for involving Ukrainian children in European education point to the need for international coordination of dual pathways. One in five students combines local school education with Ukrainian online education, which poses a challenge for administration and pedagogy. There is a need for international agreements on mutual recognition of educational achievements, flexible schedules, and even the possibility of simultaneous learning in two educational systems. According to the OECD (2024), education integration policy is crucial to helping mobile populations, and the Ukrainian case can serve as an example for other crisis situations.

In conclusion, the study showed that distance learning can become more inclusive during wartime through a combination of technological support, methodological training for educators, adaptive organizational policies, and digital inclusion policies. At the same time, there are still significant challenges related to regional inequality, economic barriers, and psychological pressure on teachers and students, which require a systematic and long-term solution in education policy.

CONCLUSIONS

The article critically examines the prospects and shortcomings of inclusive distance learning in Ukraine under martial law, based on official data from international organizations and national agencies for 2022–2025. Four groups of indicators that were analyzed (accessibility of distance learning, barriers to inclusiveness, support measures, and adaptive strategies) provided a comprehensive picture of the factors that determine the inclusiveness of online learning in extreme conditions.

The study found that distance learning has become the most important tool for ensuring the continuity of education for Ukrainian children. The four forms of participation in formal education identified show that almost fifty percent of students depend on distance or blended learning formats. At the same time, six percent of children do not participate in the education system, which indicates the limitations of the inclusive capabilities of existing online solutions. The most critical barriers to inclusiveness are considered to be territorial digital inequality, with a range of 100–63 subscriptions per 100 inhabitants, the destruction of 3,373 schools, and systemic disruptions caused by unrest and power shortages. All these obstacles have a disproportionately negative impact on the most vulnerable groups: internally displaced persons, children born into low-income families, and students in areas with low digital infrastructure.

Adaptive strategies were developed to address this: asynchronous materials, offline packages, hybrid schedules, and underground classrooms. Reaching over fifty thousand teachers with digital tools and training seven thousand four hundred educators has led to inclusivity, but it is still not enough.

These findings are relevant for education policy. It is proposed to invest specifically in digital infrastructure in areas with low coverage, subsidize Internet access among vulnerable communities, increase teacher training, and apply universal design to learning standards. The situation in Ukraine can teach countries experiencing humanitarian crises to apply best practices.

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