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TRAINING STUDENTS-TECHNICIANS DURING WARTIME: ADAPTIVE STRATEGIES AND INNOVATIONS IN UKRAINE

The war in Ukraine severely disrupted all levels of education, including technical and vocational education and training (TVET). As educational institutions were damaged, students displaced, and national priorities shifted to survival and recovery, Ukraine’s technical education sector demonstrated exceptional resilience.

This article explores the adaptive strategies and innovative practices employed in Ukraine to sustain technical education under crisis conditions. It examines how institutions have integrated digital technologies, restructured curricula, leveraged international partnerships, and developed context-specific approaches to overcome logistical, psychological, and infrastructural barriers. The wartime context has not only tested the resilience of Ukraine’s education system but has also accelerated long-overdue reforms and spurred new forms of pedagogical creativity. By analyzing these developments, the article offers insights that may be valuable for other countries facing educational disruptions due to conflict, natural disasters, or other large-scale emergencies.

Drawing on case studies, government reports, and international collaborations, the study identifies seven key areas of innovation: digital transformation, modular learning, mobile training units, public-private partnerships, psychosocial support, curriculum adaptation, and international cooperation. These responses not only ensured continuity of education under crisis conditions but also laid a foundation for long-term reform and resilience in the post-war era.

The war in Ukraine has tested the limits of technical education systems, yet it has also demonstrated the power of innovation and resilience. Adaptive strategies – ranging from digital platforms and mobile labs to trauma-informed teaching and wartime curricula – have kept technical students learning and contributing during national crisis.

As Ukraine looks toward reconstruction, its experience offers a model for other countries facing conflict, displacement, or disaster. Embedding flexibility, relevance, and support into education systems will be essential for building a skilled workforce capable of meeting the challenges of both war and peace.

Key words: *technical education systems, wartime context, educational institutions, educational disruptions, adaptive strategies.*

Problem statement in general form and its relation to important scientific or practical tasks. Wartime has historically disrupted formal education, often deprioritizing it in favor of national defense and humanitarian concerns. The full-scale Russian invasion of Ukraine in 2022 has profoundly disrupted every aspect of Ukrainian society, including the nation’s educational system. Among the most severely affected sectors is technical and vocational education, which plays a critical role in sustaining the country’s economic resilience and post-war recovery. As universities and colleges faced bombings, displacement, power outages, and unstable internet connectivity, they were forced to rapidly rethink how to train the next generation of engineers, IT specialists, construction workers, and other vital professionals. Despite the challenges, Ukrainian educators and institutions have demonstrated remarkable adaptability, resourcefulness, and innovation in ensuring the continuity and quality of technical education during wartime.

However, in the context of modern conflict, particularly in technologically advanced societies, technical education becomes even more essential. It ensures the availability of skilled workers for infrastructure repair, medical services, communications, and logistics – sectors that are crucial for both survival and post-conflict recovery.

The war in Ukraine has accelerated innovations in technical education that may have lasting impacts

beyond the conflict. Flexibility, decentralization, and digitalization have emerged as key factors reflecting a broader shift toward resilience-oriented education. These adaptations offer valuable practice for other nations facing conflict or disaster and highlight the essential role of technical training in both crisis response and long-term recovery. The war in Ukraine presents a contemporary case study of how a nation at war can adapt its technical education system to maintain continuity and relevance.

Formulation of the article's goal is to analyze the strategies adopted by Ukrainian technical and vocational institutions since the onset of the conflict and to examine how these responses have to be shaped by digital innovations, logistical constraints, psychological needs, and international support, offering valuable insights for other conflict-affected regions.

Methodology. This study employs a qualitative multi-method approach and content analysis to identify innovations. The study also draws on comparative historical examples of wartime education to contextualize Ukraine's experience.

An analysis of recent research and publications. Kurapov A., Pavlenko V., Drozdov A., Bezliudna V., Reznik A., Isralowitz R. Determine the understanding of the Russian-Ukrainian war impact on university students and personnel; Wanhua Ye enhances English Language Education in Shenzhen Polytechnic University: Strategies for Effective Teaching and Learning; Khomenko O. discusses Pedagogical Concept of Integrative Teaching and Learning in the Context of Interdepartmental; Sandy T. Soto, Julio Chumbay Guncay discover Strategies and techniques to enhance student motivation in the EFL classroom; Yousef Almoslamani defines attitude of higher education learners toward online examination; Semigina T., Stoliaryk O., Slozanska H. study how to prepare Ukrainian social workers: adapting higher education to wartime requirements; Lavrysh Y., Lytovchenko I., Lukianenko V., Golub T. Implement teaching during the wartime: Experience from Ukraine.

Presentation of the basic research material. The wartime context in Ukraine has fundamentally reshaped the landscape of technical education, prompting educators, policymakers, and students to rethink the methods, priorities, and goals of professional training. The adaptive strategies that emerged during this period reflect both an immediate response to crisis conditions and a broader, more structural transformation of technical education. This discussion unpacks key themes that have emerged from Ukraine's experience and explores their wider implications for education systems operating under extreme stress. As the Ministry of Education and Science of Ukraine [5] has launched an interactive map "Education under attack" to track destructions of Ukrainian educational institutions due to russian aggression against Ukraine.

Rapid digitalization, modularization, and decentralization of TVET [4] in Ukraine reveal how flexible, student-centered models can sustain learning under extreme conditions "focusing on understanding and addressing students' motivations, preferences, and habits in this unique context' as suggested by the investigators [1]. The researchers [3] consider that "education can be a powerful catalyst for societal transformation, equipping students with the skills they need to meet current and future challenges."

Ukraine's experience underscores the importance of educational resilience and adaptability in times of armed conflict. While the war severely strains resources, it can also accelerate innovation as:

- **Rapid Digital Transformation Under Duress**

The destruction of physical infrastructure prompted an immediate shift to online learning. One of the most significant shifts observed during the war has been the accelerated digitalization of technical education. Faced with the physical destruction of campuses and the displacement of faculty and students, institutions rapidly transitioned to remote and hybrid learning models. Digital platforms such as Google Classroom, Zoom, and Moodle became essential tools for instruction. The Ministry of Education [5] supported this transformation by providing teacher training and distributing digital devices in partnership with international donors. While digitalization was already underway before the war, the urgency of wartime conditions forced a scale and speed of implementation previously unseen. Virtual laboratories, online simulators, and open-source software platforms became essential tools for maintaining continuity in technical disciplines such as engineering, computer science, and construction.

However, this transition also exposed significant disparities in digital infrastructure, particularly between urban and rural areas. Issues such as unstable internet access, lack of electricity, and limited access to devices hindered the learning process for many students. In response, universities began implementing flexible schedules, asynchronous learning modules, and low-bandwidth resources to accommodate these challenges. These innovations offer valuable lessons for building more inclusive and adaptable digital education systems in the future.

The *All-Ukrainian School Online project*, initially designed for general education, was expanded to include technical subjects. Practical subjects were augmented with video demonstrations, simulations, and virtual labs, ensuring students could continue their learning even in displacement or shelter.

In addition, public-private and international cooperation have become key enabling factors. These partnerships allowed for the pooling of resources,

technology transfer, and alignment of education with both immediate and long-term national priorities.

- **Modular and Competency-Based Learning**

Recognizing the instability of the student population – due to internal displacement, military service, or caregiving responsibilities – many institutions adopted modular learning. Students could complete discrete skill units and return to continue their education if circumstances allowed.

Competency-based education was emphasized over time-based systems, focusing on demonstrable skills rather than rigid academic calendars. The authors [1] highlight "a balanced approach to goal-setting, with a significant focus on both short-term milestones and long-term aspirations. It emphasizes the importance of flexible learning environments and adaptive educational strategies in supporting language learning during challenging circumstances. Recommendations include leveraging technology, promoting goal-setting skills, and fostering supportive learning environments." This model ensured that even brief periods of study could contribute meaningfully to professional qualification.

- **Mobile and Decentralized Training Units**

With some regions inaccessible due to military operations or occupation, mobile technical education units were deployed including: *mobile workshops for mechanics and electrical training; satellite-connected its labs for displaced students; field-based training in rural or safer western regions.* These units were funded through international partnerships and served as lifelines for maintaining hands-on skills development.

- **Curriculum Adaptation to Wartime Needs**

Another key aspect of wartime adaptation has been the reconfiguration of curricula to meet current and future needs. Many technical programs began integrating modules related to emergency response, infrastructure rehabilitation, cybersecurity, energy independence, and military engineering. This shift reflects an urgent need to equip students with skills directly applicable to the national context, including reconstruction and defense.

The emphasis on contextual relevance also encouraged stronger collaboration between educational institutions and industry partners. Internships, project-based learning, and mentorship programs involving real-world wartime challenges not only enhanced the practical orientation of technical education but also strengthened students' sense of civic responsibility and national contribution. In the long term, such approaches could serve as a model for aligning technical education with societal needs, especially during periods of crisis.

Curricula were rapidly updated to align with the realities of war. New short-term training programs emerged in fields such as *emergency repair and electrical restoration; drone operation and unmanned vehicle maintenance; basic paramedical care and trauma response; cybersecurity and communications infrastructure.* These adaptations ensured that students' education was immediately relevant to national and local needs, fostering a sense of purpose and contribution. The authors [2] substantiate "various ways to maximize the effectiveness of psychological, methodological, and technological resources, which play a crucial role in ensuring the quality of blended learning in wartime. These approaches will be particularly valuable for developing various strategies and tools to support teachers in implementing effective blended learning models, as well as adapting teaching materials and methods to conditions of limited resource access and altered educational environments".

- **Psychological and Social Support**

The mental health and well-being of students and faculty emerged as a crucial concern during wartime. Exposure to trauma, displacement, and uncertainty had a profound impact on the learning environment. Recognizing this, many institutions introduced psychological support services, peer networks, and resilience-building workshops. These efforts were critical not only for maintaining educational performance but also for fostering a supportive community amid widespread disruption.

The Ukrainian experience underscores the need for integrating psychological resilience into the fabric of educational planning – especially in contexts where learners are exposed to prolonged stress or trauma. This component is often overlooked in technical education, which traditionally focuses on hard skills, but the war has made it clear that emotional and psychological well-being are essential for effective learning and professional development.

Wartime trauma among students and educators posed a major barrier to learning. In response, institutions integrated psychosocial services into their educational offerings as *online and in-person counseling; flexible attendance policies for students dealing with trauma; mental health training for teachers.* This support was especially critical in regions that experienced repeated shelling or occupation.

- **Public-Private Partnerships**

Amid labor shortages and urgent repair needs, industries collaborated with TVET institutions [4]. Construction firms, IT companies, and healthcare providers offered *remote apprenticeships and project-based learning; material resources (tools, internet access); placement opportunities* for students nearing graduation. This collaboration not only ensured continued learning but also directly supported the wartime economy and infrastructure recovery efforts.

• **International Collaboration and Knowledge Exchange**

International organizations played a central role in sustaining Ukrainian technical education. UNESCO, UNICEF, the European Training Foundation [6, 7, 8] and other partners provided funding, curriculum resources, and technical expertise. These collaborations helped *develop emergency education frameworks; train instructors for online delivery; standardize credentials to facilitate student mobility.* Cross-border educational partnerships also allowed some students to continue their training abroad through temporary placements or virtual exchanges.

Ukraine's technical education sector benefited significantly from international support and cooperation during the war. Universities formed partnerships with institutions abroad to share digital resources, host displaced students, and co-develop joint programs. These collaborations not only provided immediate relief but also facilitated the exchange of innovative practices and enhanced the global visibility of Ukrainian science and education.

Furthermore, participation in international projects and networks helped maintain academic standards and research continuity despite local disruptions. The war thus catalyzed a more global orientation for Ukrainian technical education, which may have long-term benefits in terms of competitiveness and innovation capacity.

• **Challenges and Risks Moving Forward**

However, challenges remain. While the adaptive strategies employed have shown impressive effectiveness, they are not without challenges. The prolonged reliance on emergency measures risks institutional fatigue and quality degradation if not backed by systemic support and investment. Additionally, there is a danger that temporary solutions – such as compressed curricula or reduced practical hours – may lead to skill gaps if not addressed during the reconstruction phase.

Furthermore, rebuilding damaged infrastructure and ensuring the return of displaced students and faculty will require sustained effort and resources. The success of postwar educational reform will depend not only on continuing innovation but also on stable funding, policy coherence, and international solidarity.

Inequalities in access to digital technologies, inconsistent mental health support, and regional differences in institutional capacity risk deepening the post-war education gap. But the researchers [3] believe that "even in times of crisis, higher education can and should be a beacon of hope and progress, a key driver in promoting sustainable development." Long-term planning will be needed to harmonize emergency innovations with sustainable reforms as the scientists [2] outline "key destructive impacts of the war on higher pedagogical education at three levels: national, institutional, and individual participants of the educational process, considering three components (psychological, methodological, technological).

In summary, the wartime training of technical students in Ukraine has catalyzed a series of rapid, innovative, and often deeply human responses to an extreme crisis. While the situation remains complex and fluid, the strategies adopted provide valuable insights into how technical education systems can be made more resilient, responsive, and relevant. The Ukrainian case demonstrates that even in the face of war, education can persist – and even evolve – to meet the needs of both the present and the future.

Conclusion. The experience of training technical students in Ukraine during wartime highlights the resilience, adaptability, and innovation of the country's educational system in the face of unprecedented challenges. Despite the destruction of infrastructure, displacement of students and faculty, and ongoing security threats, Ukrainian institutions have found ways to maintain and even enhance the quality of technical education. Through the rapid adoption of digital tools, flexible learning models, international collaboration, and a renewed focus on practical skills aligned with wartime and postwar needs, educators have laid the groundwork for a more agile and future-ready system.

The crisis has revealed both vulnerabilities and opportunities – exposing gaps in preparedness, while also catalyzing reforms that may otherwise have taken years to implement. It has underscored the importance of flexible curricula, psychological support, infrastructure resilience, and the strategic integration of modern technologies in technical education. Most importantly, it has reaffirmed the critical role of technical specialists in national defense, reconstruction and economic sustainability.

As Ukraine looks toward recovery and rebuilding, the lessons learned during this period should not be viewed solely as temporary measures but as a foundation for long-term transformation. The innovations developed in wartime can inform global best practices in crisis-resilient education and serve as a model for other countries facing similar disruptions. Investing in the continuous modernization of technical education will be essential not only for Ukraine's recovery but also for strengthening global educational resilience in an increasingly uncertain world.

In terms of **prospects** in the research area, systematic investigations are required to identify training strategies at higher institutions in postwar period.

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Ісаєва О. С., Кушка Б. Г. Підготовка студентів-техніків у воєнний час: адаптивні стратегії та інновації в Україні

Війна в Україні серйозно порушила функціонування всіх рівнів освіти, зокрема системи професійно-технічної освіти і навчання (ПТО). Освітні заклади зазнали руйнувань, студенти були змушені покинути місця навчання, а національні пріоритети змістилися в бік виживання та відновлення. У цих надзвичайно складних умовах система технічної освіти України виявила виняткову стійкість.

У статті досліджуються адаптивні стратегії та інноваційні практики, які були запроваджені в Україні з метою забезпечення безперервності технічної освіти в умовах кризи. Аналізується, як освітні установи інтегрували цифрові технології, оновили навчальні програми, активізували міжнародне партнерство та розробили контекстно-залежні підходи для подолання логістичних, психологічних та інфраструктурних перешкод. Військовий контекст не лише випробував на міцність українську освітню систему, а й пришвидшив назрілі реформи та сприяв появі нових форм педагогічної творчості. Досвід України може слугувати джерелом цінних уроків для інших країн, які зіштовхуються з освітніми викликами внаслідок конфліктів, природних катастроф чи інших масштабних надзвичайних ситуацій.

Дослідження також виокремлює сім ключових напрямів інновацій: цифрова трансформація, модульне навчання, мобільні навчальні підрозділи, державно-приватне партнерство, психосоціальна підтримка, адаптація навчальних програм і міжнародна кооперація. Ці заходи не лише забезпечили безперервність освіти в умовах кризи, але й заклали підґрунтя для довгострокових реформ і підвищення стійкості у повоєнний період.

Війна випробувала технічну освіту на межі її можливостей, але водночас продемонструвала силу інновацій та адаптивності. Адаптивні стратегії – від цифрових платформ і мобільних лабораторій до навчання з урахуванням травматичного досвіду та створення програм, релевантних до воєнного часу – дозволили студентам технічних ЗВО продовжувати навчання та робити внесок у суспільство під час національної кризи.

У контексті майбутнього відновлення Україна демонструє досвід, що може стати зразком для інших країн, які стикаються з конфліктами, вимушеним переміщенням або катастрофами. Інтеграція гнучкості, актуальності та підтримки в системи освіти буде ключовою умовою для формування кваліфікованої робочої сили, здатної ефективно діяти як у воєнний, так і у мирний час.

Ключові слова: *система технічної освіти, воєнний контекст, освітні заклади, освітні виклики, адаптивні стратегії.*