Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Distance learning as a benefit or risk for physical and mental health: the perspective of Ukrainian students

Maryna Nesterenko

mm_nesterenko@bdpu.org.ua

Berdyansk State Pedagogical University

Karyna Koval

Berdyansk State Pedagogical University

Kateryna Saprankova

Berdyansk State Pedagogical University

Yana Sychikova

Berdyansk State Pedagogical University

Anzhelika Lesyk

Berdyansk State Pedagogical University

Andrian Kuza

Berdyansk State Pedagogical University

Article

Keywords:

Posted Date: June 22nd, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9333442/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Distance learning as a benefit or risk for physical and mental health: the perspective of Ukrainian students

Abstract

Distance learning has become a stable component of Ukrainian higher education following the COVID-19 pandemic and the full-scale war, yet its implications under conditions of prolonged instability remain insufficiently explored. This study investigates students' perceptions of the impact of distance learning on physical and mental well-being, social interaction, and professional preparation in a wartime context.

Data were collected through an online survey of 577 students at a relocated Ukrainian university and analyzed using descriptive and inferential statistics alongside thematic content analysis.

The findings indicate that distance learning is associated with moderate physical health risks but does not function as a primary driver of deteriorating mental health. Many students report enhanced psychological comfort and perceived safety when studying remotely. Experiences vary significantly across stages of academic progression, suggesting academic maturity as a key factor in adaptation to digitally mediated learning environments. Most respondents do not associate distance learning with reduced professional competence and evaluate it as a flexible format supporting continuity and resilience in crisis settings.

Introduction

Distance learning in recent years has transformed from an alternative mode of education into a structurally significant element of the higher education system. The emergency, yet generally positive, experience of distance learning during the COVID-19 pandemic has altered traditional approaches to organizing educational activities and interactions within educational institutions, as well as public attitudes toward it. Primarily, this is due to its accessibility. The дистанційна форма взаємодії significantly expanded access to education by enabling learning regardless of location and ensuring flexibility in the organization of the educational process (Culduz, 2024). However, certain factors inherent in distance learning (reduced direct interpersonal interaction, limited social support, increased informational load, and social isolation) act as determinants of negative changes in students' psychological and physical condition (Sharma, 2025; Alarabiat, 2024). Equally important is students' emotional well-being during distance learning, which depends on the organization of academic interaction (maintaining a high quality of instruction and stable communication with instructors) and the level of trust in the university (Rezapour et al., 2022; Lischer et al., 2021). Thus, despite its advantages, these transformations create potential risks for both physical and mental health.

Among the most common negative consequences of distance learning, researchers highlight the deterioration of students' physical condition due to insufficient physical activity. For instance, during the COVID-19 pandemic, students at Taiwanese universities demonstrated a significant decrease in physical activity, with more than 50% of respondents reporting a substantial reduction in their physical load. The most pronounced decline was observed among male students, whose time spent in vigorous physical activity decreased by 74%, compared to 39% among female students, indicating gender-related differences in physical activity patterns under distance learning conditions (Chu et al., 2022). Other studies have also reported somatic complaints such as eye strain and drowsiness (Husini et al., 2010), back and neck pain (Zheng et al., 2024), as well as weight gain (Długosz et al.,

2022). However, overall, the impact of distance learning on students' physical health does not show clear gender determination, as the emergence of somatic symptoms is more closely associated with the duration of online learning, the volume of independent work, individual characteristics, and behavioral patterns rather than gender (Unnisa, 2021; Briones et al., 2023).

In addition to physical effects, distance learning also has a noticeable impact on students' mental health. Some studies indicate that prolonged engagement in online learning is accompanied by impaired attention and concentration, increased irritability, and cognitive fatigue (Zhao et al., 2021; Pohorilyak et al., 2023). One characteristic manifestation of this condition is the phenomenon of "virtual fatigue" which combines elements of social isolation with physical and psycho-emotional strain (Briones et al., 2023). For a significant proportion of students, the sudden transition to distance learning was also associated with increased levels of stress and anxiety, and in some cases with the emergence of depressive symptoms requiring professional psychological support (Tarawneh et al., 2024). Some empirical studies additionally point to a link between the distance learning format and psycho-emotional tension caused by a lack of social interaction, feelings of uncertainty, and fear, negatively affecting overall psychological well-being (Othman et al., 2025).

Students' psychological state during distance learning is also influenced by the transformation of the functions of the home environment, leading to a blurring of boundaries between spaces for rest and active learning. Such monotony affects psychological resilience and motivation to learn (Noskova et al., 2024; Inan et al., 2025).

However, for certain groups of students with special educational needs, particularly those with symptoms of hyperactivity, distance learning may have a predominantly positive effect on psychological well-being, as the virtual environment allows for individualized learning and reduces the intensity of direct social interactions (Alkhawashki et al., 2024).

Thus, distance learning can have both positive and negative consequences for students. On the one hand, it expands opportunities for flexible learning organization and independent work; on the other hand, it is associated with increased psycho-emotional tension, anxiety, and frustration under the influence of external factors (Zhytova et al., 2023). Therefore, much depends on the context and individual conditions.

At the same time, most previous studies have examined the impact of distance learning in the context of a pandemic or relative social stability, which differs significantly from students' educational experiences under conditions of military instability. Research in the field of education in emergencies suggests that continuity of education performs not only an academic but also a protective function, providing physical, psychosocial, and cognitive support (Mitchell et al., 2020). In this context, distance learning is considered a tool for maintaining stability and life routines, as well as a mechanism for accessing knowledge in situations where physical mobility and the functioning of educational infrastructure are limited or unsafe (El-Sbahi et al., 2024). Studies on education in armed conflict contexts also recognize distance learning as a viable means of reducing security risks and supporting learners' psychosocial stability (Hanon, 2022), thereby helping to restore a sense of "normality and continuity of life" (Nicolai, 2009).

At the same time, existing empirical research provides limited understanding of how distance learning is perceived by students under conditions of prolonged military instability, when the online format ceases to be a temporary solution and becomes a fundamental educational reality. In particular, insufficient attention has been paid to how students in such contexts evaluate the impact of distance learning on their physical health, psycho-emotional state, sense of security, and the quality of professional training.

Therefore, the study was guided by the following research questions:

1. What physical health complaints do Ukrainian students associate with distance learning?
2. How is distance learning during wartime related to students' stress, anxiety, and psycho-emotional exhaustion, and which factors are perceived as most influential?
3. How do students evaluate distance learning in terms of safety, psychological comfort, and the quality of professional training?

This gap determined the aim of our study – to analyze the experiences of Ukrainian students for whom distance learning is compulsory, prolonged, and directly associated with the context of a full-scale war. In addition, the study explores whether students' experiences vary depending on selected contextual and academic factors.

Methodology

Participant sample characteristics

The study involved 577 students of XXX University, an institution temporarily relocated due to the war in Ukraine and currently operating in a fully online format. Among the respondents, 86.8% were female and 12.8% were male, while the remaining participants either did not specify or declined to indicate their gender. As the study did not aim to examine gender-related correlations, this characteristic was treated as descriptive. The age distribution of participants ranged from 18 to 27 years and older. Notably, 66.6% of respondents held the status of internally displaced persons as a result of military actions.

Instrument and Procedure

To collect empirical data, the research team developed a structured online questionnaire (Appendix 1) based on a review of the scientific literature on the impact of distance learning on physical and mental health. The instrument consisted of three sections: (1) demographic information (gender, age, year of study, and internally displaced person status), (2) a physical health block, and (3) a mental health block.

Most items were closed-ended, employing Likert-scale response options to enable a more precise assessment of students' perceptions regarding various aspects of the impact of distance learning. The questionnaire also included several open-ended questions to facilitate a more in-depth analysis of participants' experiences and to complement the statistical data with illustrative examples. The integration of quantitative and qualitative approaches allowed for the collection of a robust dataset suitable for comparison and for addressing the research questions (Ghanad, 2023; Wallwey & Kajfez, 2023; Pilcher & Cortazzi, 2024).

Prior to administration, the questionnaire underwent internal validation by two experts: one in educational sciences and the other in psychology. This procedure improved the overall coherence of the instrument and helped eliminate ambiguities in item formulation. In addition, the questionnaire was pilot-tested on a small sample of students to ensure clarity and comprehensibility.

Data collection was carried out in October 2025 using Google Forms. This approach was optimal for the rapid and systematic collection of responses from a large number of participants, while also ensuring participants' comfort and safety, given their geographical dispersion and the security challenges within the country.

Quantitative Data Processing

The analysis of the collected data was conducted in several stages. At the first stage, descriptive statistical methods were applied to summarize respondents' answers and to identify general trends in students' perceptions of distance learning under conditions of martial law. The results are presented in the form of tables and charts using percentage distributions.

To deepen the interpretation of the findings and to examine potential differences in students' experiences, inferential statistical analysis was additionally performed. In particular, Pearson's chi-square (χ^2) test of independence was used to assess associations between categorical variables (year of study, internally displaced person status, and intensity of online learning) and key indicators of students' educational experiences.

To determine the practical significance of the identified associations, Cramér's V coefficient was calculated. Its interpretation followed commonly accepted benchmarks in social and educational research (small effect: up to 0.10; medium effect: around 0.30; large effect: 0.50 and above). This approach made it possible not only to establish the presence of statistically significant relationships but also to evaluate their substantive strength.

The questionnaire was designed as a set of single-item indicators reflecting specific aspects of students' experiences rather than multi-item psychometric scales. Therefore, internal consistency measures such as Cronbach's alpha were not applicable. Instead, the study focused on descriptive and relational analysis of independently measured variables.

All statistical calculations were performed using standard analytical data processing tools.

Qualitative Data Processing

Responses to open-ended questions were analyzed using elements of thematic content analysis, followed by a quantitative assessment of frequency of occurrence. At the initial stage, all responses were manually reviewed to identify recurring themes and to exclude neutral answers that did not contain meaningful information (e.g., "I don't know", "nothing", "–", "hard to say").

Following this initial screening, key response categories were identified and coded. Individual responses could be assigned to multiple categories if they contained complex or multifaceted descriptions. After coding, the frequency of each category was calculated and expressed as a percentage of the total number of valid responses. To ensure data consistency, manual tabulation was employed, with prior normalization of synonyms and variations in wording (for example, "sitting at the computer", "remaining in one position", and "back pain" were grouped into a single category).

This approach enabled a qualitative interpretation of textual data while allowing for their quantitative representation, facilitating further analysis and integration into the main results of the study.

Results

The study results are presented in accordance with an analytical framework that involves a sequential progression from a generalized description of students' experiences with distance learning to the identification of structural factors associated with its variability under conditions of martial law.

At the first stage, the findings of the descriptive analysis are presented, outlining the general characteristics of students' experiences. At the second stage, the results of the inferential analysis are reported, focusing on the identification of factors associated with differences in the perception of distance learning.

4.1 Descriptive Analysis

4.1.1. Students' Physical Health During Distance Learning

The geographical location of XXX University in close proximity to the frontline necessitates the organization of the educational process in a distance format. Therefore, our primary interest was to determine the average number of hours per day students spend on online learning (including lectures, practical classes, and independent study). To this end, respondents were asked a corresponding question.

The majority of participants (47.1%) reported that online learning takes, on average, between 3 and 5 hours per day. A further 21.5% indicated spending more time on learning activities, specifically 6-8 hours daily. Additionally, 6.9% of respondents reported spending more than 8 hours per day on independent study and learning.

The overall self-assessment of the impact of distance learning on physical health was distributed as follows: 55.8% of respondents rated the impact as neutral, 15.1% as rather negative, and 2.1% as extremely negative, while 27.0% assessed it as rather positive. The proportion of positive evaluations represents a substantial segment of the sample and indicates the presence of a group of students for whom the distance learning format is associated with a satisfactory physical condition.

Students' physical health was examined using the following indicators: back and neck pain or discomfort, changes in eating habits, symptoms of visual fatigue, and sleep quality (Figure 1).

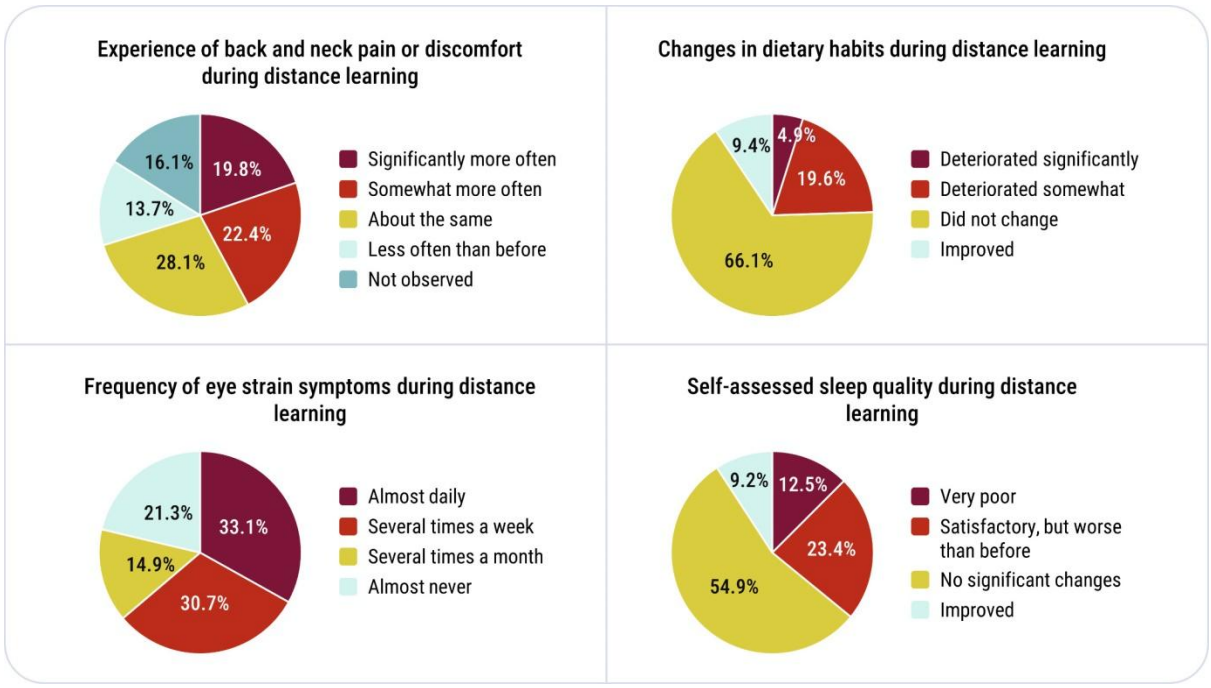


Figure 1. Subjective assessment of the impact of distance learning on students' physical health by individual indicators

Nearly one-third of respondents (28.1%) reported that the frequency of back and neck pain or discomfort had not changed compared to the period of offline learning. At the same

time, 19.8% indicated experiencing these symptoms significantly more often, while 22.4% reported a moderate increase.

The majority of students (66.2%) reported no changes in their eating habits during distance learning. A deterioration in eating patterns was noted by 24.5% of respondents, whereas 9.4% reported improvements.

Symptoms of visual fatigue were found to be widespread among students: 33.1% of respondents experienced them almost daily, and a further 30.7% reported experiencing them several times a week. Meanwhile, 14.9% indicated that such symptoms occurred several times a month, and 21.3% reported experiencing them almost never.

More than half of the participants (54.9%) stated that their sleep quality had not changed significantly during the period of distance learning, while 9.2% reported improvements. At the same time, 23.4% assessed their sleep quality as worse than during offline learning, and 12.5% described it as very poor.

Table 1 presents the responses and their frequencies to the open-ended question: “What most negatively affects your physical well-being during distance learning? Please provide examples from your personal experience”.

Table 1. Main factors of physical discomfort during distance learning

Factors	Frequency of mentions (as a % of the number of valid responses)	Sample answers
Prolonged sitting and inactivity	68%	● "Long sitting at the computer", ● "Back, neck hurt"; ● "Uncomfortable to sit - lower back hurts"; ● "Sitting without breaks for several hours".
Excessive use of screens and eye strain	43%	● "Distance learning has affected my vision"; ● “Eyes get tired, redness"; ● "After the screen – headache and dryness."
Lack of exercise in the fresh air	30%	● "Not enough walks"; ● "Lack of physical exercise"; ● "Not enough air – lethargy."
Stress and emotional tension	18%	● "Excitement due to air raids"; ● "No internet during the holidays"; ● "Constant stress due to the situation in the country."
Lack of a quality workplace	15%	● "Uncomfortable chair, I lean towards the screen"; ● "No desk, I work from bed"; ● "I study from my phone - it's hard to see, my neck hurts."

Data on the regularity of students' physical activity showed a heterogeneous distribution. The largest proportion of respondents (47.7%) reported engaging in physical exercise 1-2 times per week; 17.5% exercised 3-4 times per week, while 19.4% reported being physically active almost daily. At the same time, 15.4% of respondents indicated that they did not engage in regular physical activity.

These findings suggest that, for a substantial proportion of students, physical activity may serve as a potential compensatory factor mitigating the negative effects of distance learning on physical health; however, this practice is not universal.

To assess the possible relationship between the level of physical activity and the frequency of back and neck pain, a cross-tabulation analysis of students' responses was conducted. The distribution is presented as percentages within each pain category (Figure 2).

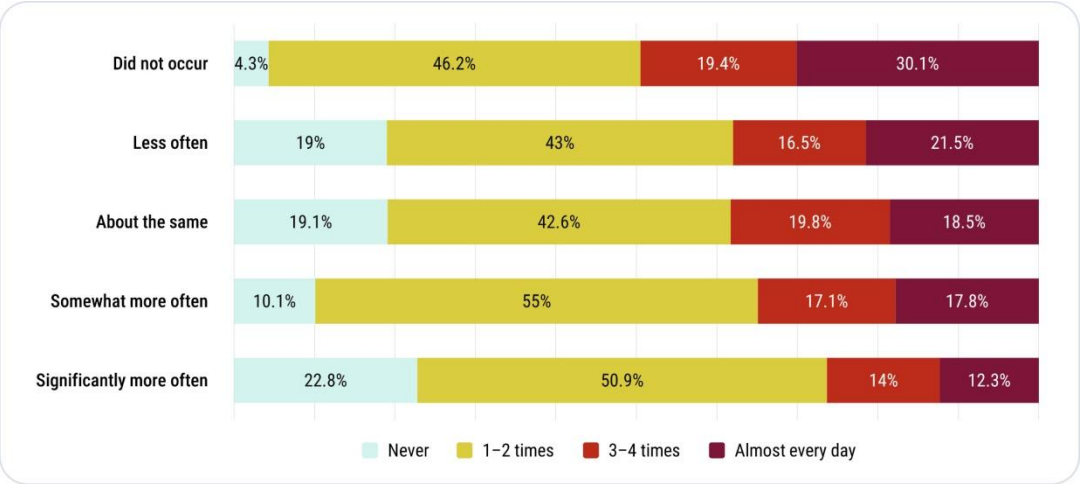


Figure 2. The relationship between the level of physical activity and the frequency of back and neck pain

The results indicate the presence of a discernible trend: among students who did not report pain, higher levels of regular physical activity were more frequently observed, whereas groups with more frequent pain symptoms included a relatively larger proportion of individuals with low or no engagement in physical exercise. The identified association is statistically significant ($\chi^2(12) = 29.34$, $p = .004$; Cramér's $V = .13$), although it is characterized by a small effect size.

4.1.2. Mental health and emotional well-being

The impact of distance learning on physical health was examined in relation to students' psycho-emotional state, as some respondents associated physical discomfort with stress and emotional strain. The next block of analysis focuses on indicators of mental health.

Figure 3 shows that for 48.2% of respondents, levels of stress and anxiety during distance learning remained approximately the same as during face-to-face learning. An increase in these levels was reported by 25.5% of students, with 18.5% describing their stress as somewhat higher and 6.9% as significantly higher. At the same time, 26.3% indicated lower levels of stress and anxiety compared to offline learning.

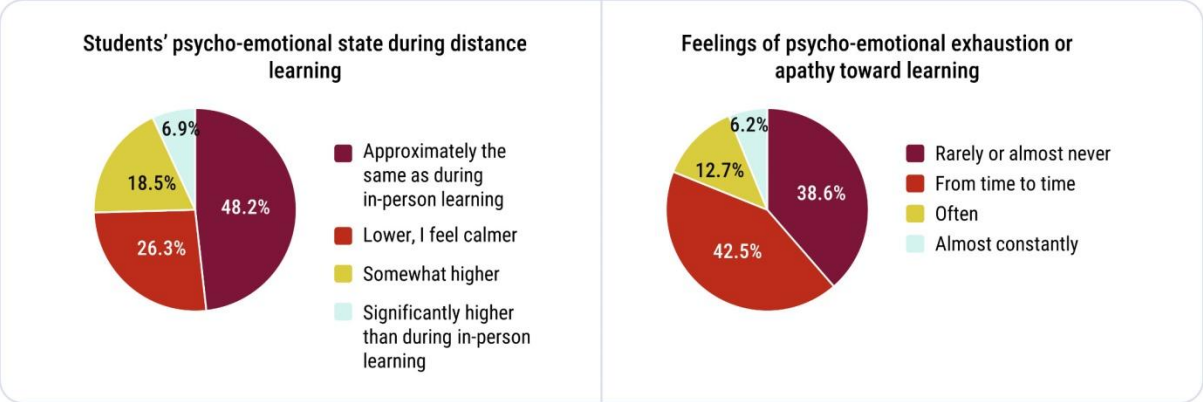


Fig. 3. Subjective assessment of the impact of distance learning on students' mental health

Psycho-emotional exhaustion and apathy toward learning were reported to occur occasionally by 42.5% of respondents. Frequent occurrence of such states was indicated by 12.7% of participants, while 6.2% reported experiencing them almost constantly. At the same time, 38.6% of students stated that such symptoms occurred rarely or almost never.

In response to the question regarding the main drawback of distance learning, 32.1% of respondents indicated that there were no significant drawbacks. Technical issues were identified as the primary stress-inducing factor by 26.3% of participants. The distribution of other responses is presented in Table 2.

Table 2. Main stressors of distance learning

Factors	Frequency of mentions (as a % of the number of valid responses)	Number of mentions (≈ n)
No drawbacks	32,1	185
Technical issues and related stress	26,3	152
Social isolation and loneliness	11,8	68
Decreased motivation and self-discipline	10,9	63
Blurred boundaries between study and personal life	10,1	58
Difficulty concentrating at home	7,1	41
Other (a combination of the above; low level of social engagement with the group; lack of recorded video lectures that can be reviewed if a class is missed due to work, etc.)	1,7	10

A substantial proportion of respondents did not associate distance learning with negative consequences, which prompted an analysis of its potential positive aspects. In

particular, perceptions of safety and psychological comfort during home-based learning under conditions of martial law were examined (Figure 4).

More than half of the students (51.8%) fully agreed that they feel safer at home, while an additional 25.0% selected the option “rather yes.” At the same time, 20.1% were undecided, and 3.1% indicated that they would feel more at ease on campus.

Thus, for the majority of respondents, distance learning is associated with a higher level of perceived safety and psychological comfort.

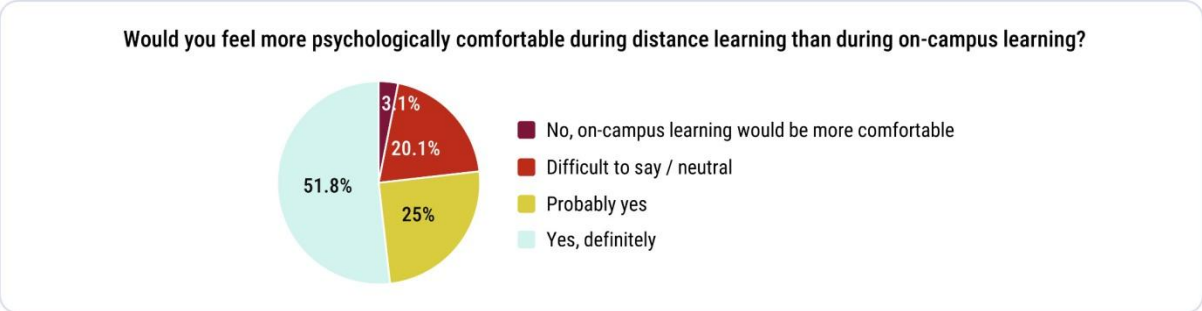


Figure 4. Self-assessment of students’ perceived psychological comfort and safety at home during distance learning under wartime conditions

The distribution of responses regarding the advantages of distance learning is presented in Table 3. For 43.0% of students, the main advantage is the ability to combine studies with work or hobbies, while 18.0% identified schedule flexibility as the key benefit. A sense of safety while studying at home was reported by 21.3% of respondents, and 10.1% highlighted savings in time and travel costs. A reduction in stress related to face-to-face interaction was selected by 2.9% of participants, and a combination of the listed factors by 1.7%, whereas 2.9% indicated that distance learning has no advantages.

Table 3. Students’ subjective evaluation of the advantages of distance learning under conditions of martial law

Factors	Frequency of mentions (as a % of the number of valid responses)	Number of mentions (≈ n)
Ability to combine studies with work/hobbies	43	248
Sense of safety at home	21.3	123
Flexible schedule	18	104
Savings in time and travel costs	10.1	58
Reduced stress from social interactions	2.9	17
No advantages	2.9	17
Other (all of the listed positive factors	1.7	10

combined)		

The overall self-assessment of the impact of distance learning on students' mental health was distributed as follows: 49.6% of respondents evaluated the impact as neutral, 40.0% as rather positive, 9.2% as rather negative, and 1.2% as extremely negative.

These findings indicate that, for the vast majority of participants, distance learning at the university does not constitute a dominant factor in the deterioration of mental health, but is instead perceived predominantly as a neutral or even beneficial mode of learning.

4.1.3. Social Interaction and Professional Skills

The evaluation of the social aspects of the educational process and the perceived development of professional competencies was carried out through the analysis of students' satisfaction with the level of informal communication with peers during distance learning (Figure 5). The largest proportion of respondents (44.0%) rated the level of informal interaction as neutral, while 42.1% reported being fully satisfied with it. Negative evaluations were less frequent: 7.7% indicated an almost complete absence of informal communication, and 7.1% reported dissatisfaction.

Responses to the open-ended question revealed variability in students' experiences. Some respondents reported the formalization of contacts and a restriction of communication to academic matters, a lack of direct interaction, and low communicative activity among peers. At the same time, other students noted the presence of regular communication through group chats, video calls, informal meetings, and similar forms of interaction. Differences in individual needs for informal communication were also observed.

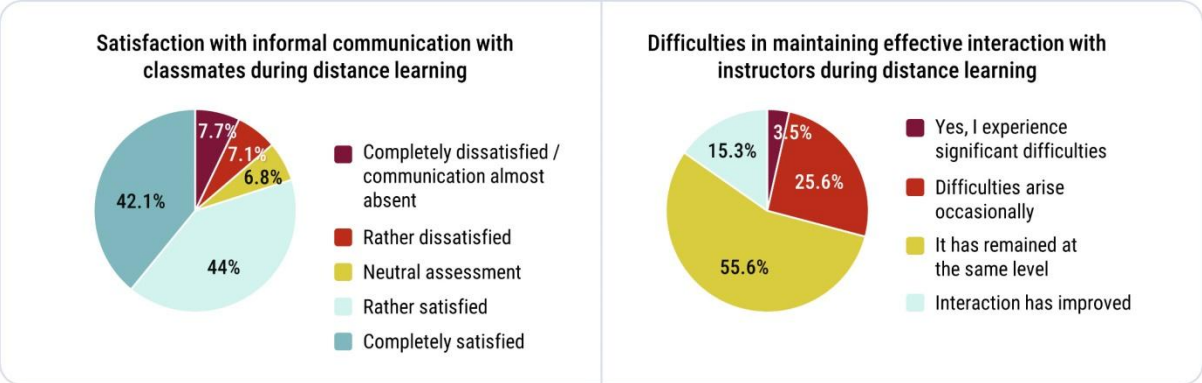


Figure 5. Students' subjective evaluation of the level of formal and informal communication during distance learning

The nature and quality of communication with instructors were also examined as a factor influencing the effectiveness of the educational process in the distance learning format (Figure 5). The majority of respondents (55.6%) indicated that interaction remained at a level comparable to face-to-face learning. Periodic difficulties were reported by 25.6% of students, while 15.3% noted an improvement in communication. Significant difficulties in interaction with instructors were reported by 3.5% of participants.

Responses to the open-ended question revealed diverse communication experiences. Some students highlighted the convenience of online interaction and the promptness of

feedback through digital channels. Others pointed to limitations in direct contact, difficulties in clarifying information, and technical barriers, including unstable internet connections and power outages. A number of respondents also noted inconsistencies in communication channels and delays in responses. Additionally, some students had no prior experience of face-to-face learning and therefore evaluated the quality of interaction exclusively within the distance learning format.

The level of students' confidence in their acquired knowledge and practical skills in the distance learning format is presented in Figure 6. A proportion of respondents (19.4%) reported feeling approximately as confident as in face-to-face learning. A further 56.0% indicated higher confidence in their competencies. At the same time, 18.5% of participants reported a decrease in confidence, while 6.1% indicated a substantial difference in favor of the face-to-face format.

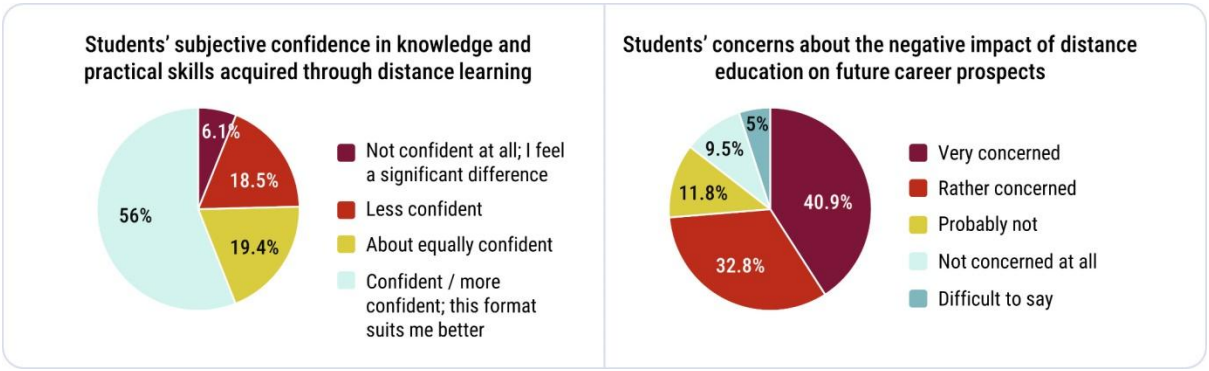


Figure 6. Students' subjective evaluation of the quality of their professional skills developed during distance learning at the university

The overall impact of distance learning on physical and mental health was evaluated by most students as positive or neutral: 44.4% of respondents indicated that it offers more advantages, while 39.5% reported that it involves approximately equal numbers of benefits and drawbacks. A predominantly negative impact was reported by 6.9% of participants, whereas 9.2% were unable to determine their position.

Responses to the open-ended question aimed at further elaborating the impact of the distance learning format were analyzed using thematic content analysis (Table 4). Most frequently, respondents combined references to psychological and organizational benefits of the distance format – such as a sense of safety, schedule flexibility, and time savings – with indications of physical strain, including reduced physical activity, visual overload, and back and neck pain. Comments regarding limitations in social interaction were also noted.

Table 4. Advantages and disadvantages of distance learning at the university under wartime conditions (summary content analysis of respondents' answers)

Category	Connotation	Category description	Frequency of occurrence (n)	% of respondents who mentioned the theme at least once

Time and resource savings	positive	No expenses for commuting, accommodation in another location, and overall domestic convenience	132	29.33
Schedule flexibility and the ability to combine different activities/roles	positive	Combining studies with work, hobbies, and childcare responsibilities	110	24.44
Deterioration of physical health	negative	Physical inactivity, back/neck pain, fatigue, and visual strain	88	19.55
Domestic comfort / convenience of the home environment	positive	Being at home is better than in the classroom	76	16.88
No or minimal impact	neutral	Statements indicating a neutral impact on health	69	15.33
Psychological comfort / reduced stress	positive	Reduced anxiety, a sense of calm at home, and less social pressure	44	9.77
Safety under conditions of martial law	positive	Greater protection from risks, air raid alerts, and travel-related exposure	28	6.22
Deficit of social interaction	negative	Lack of face-to-face interaction and student community	26	5.77
Ambivalent evaluation	neutral	Indication of the simultaneous presence of both positive and negative effects	25	5.55

The presented descriptive analysis made it possible to outline a generalized profile of students' experiences with distance learning under conditions of martial law and to identify key trends in its perception. At the same time, the aggregated nature of these results does not allow for determining the extent to which this experience is homogeneous across different groups of students.

Accordingly, the next stage of the analysis was aimed at identifying factors associated with potential variability in educational experiences. In particular, the presence of statistical associations between characteristics of the student population and indicators of distance learning perception was examined using Pearson's chi-square (χ^2) test of independence.

4.2. Structural factors of variability in students' experiences

4.2.1. Year of study as a structural factor of variability in students' experiences

The results of the χ^2 analysis revealed statistically significant associations between year of study and key indicators of students' distance learning experiences, including levels of stress and anxiety, confidence in professional knowledge and skills, perceived safety and psychological comfort, as well as the frequency of symptoms of visual strain (Table 5). The values of Cramér's V correspond to a large effect size, indicating a substantial role of the stage of the academic trajectory in structuring students' educational experiences under conditions of martial law.

Table 5. Associations between year of study and key outcomes of distance learning during wartime

Outcome variable	χ^2 (df)	p-value	Cramér's V
Stress and anxiety related to distance learning	589.66 (24)	< .001	0.51
Confidence in professional knowledge and skills	587.52 (24)	< .001	0.50
Perceived safety and psychological comfort at home	596.01 (24)	< .001	0.51
Frequency of eye strain symptoms	603.93 (24)	< .001	0.51

The obtained results indicate that the perception of distance learning is not homogeneous and varies depending on students' year of study. Accordingly, year of study can be considered an independent structural factor associated with differences in the psycho-emotional, professional, and physical dimensions of students' educational experiences.

To further clarify the nature of the identified associations, an additional descriptive analysis of response distributions across individual years of study was conducted.

4.2.2. Stress levels by year of study

The descriptive analysis of response distributions indicates that patterns of change in stress levels associated with distance learning vary depending on the stage of the academic trajectory (Figure 7). Among first- and second-year students, a more polarized distribution of responses is observed: alongside a relatively high proportion of respondents reporting a decrease in stress levels, there is also a notable share of students experiencing increased levels of tension.

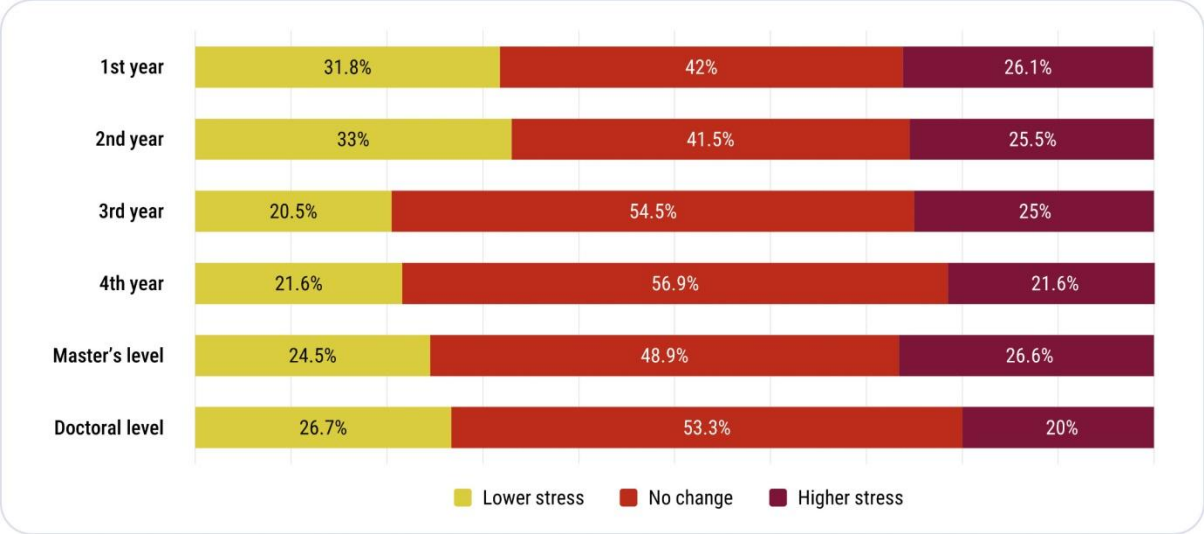


Figure 7. Relationship between students' stress levels and year of study

In contrast, among senior students, responses indicating "no change" tend to predominate, which may suggest a more stable perception of the distance learning format compared to face-to-face learning. A similar pattern is observed among master's and doctoral students. Overall, the findings suggest that with progression in the year of study, distance learning is more frequently perceived as neutral in relation to psycho-emotional well-being, whereas at earlier stages of study it is associated with greater variability in responses.

4.2.3. Perceived safety during distance learning

The analysis revealed a high level of consistency in responses regardless of year of study: the vast majority of students at all stages of academic progression reported an increased sense of safety and psychological comfort when studying from home rather than on campus. The proportion of such responses consistently exceeded 70% (Figure 8).

At the same time, the share of respondents indicating a decrease in perceived safety remained minimal. This provides grounds for considering distance learning as an environment that performs a protective function for most students under conditions of martial law. Importantly, this effect appears relatively stable across different stages of the academic trajectory, suggesting its universal nature.

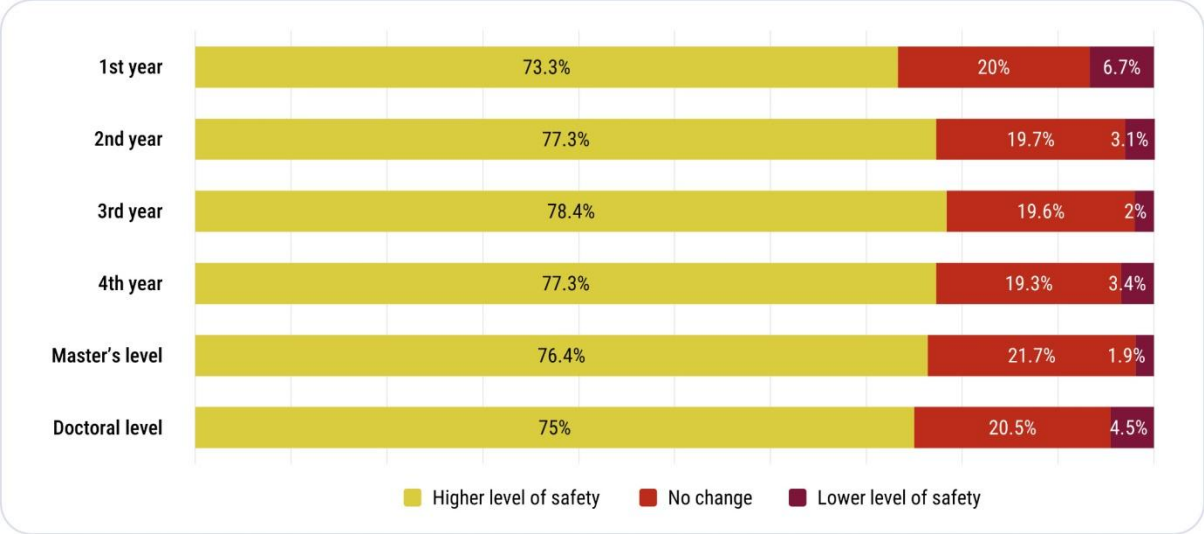


Figure 8. Relationship between perceived safety during distance learning and year of study

4.2.4. Confidence in Professional Knowledge and Skills

The results of the descriptive analysis indicate that, for the majority of students, distance learning is not accompanied by substantial changes in their sense of professional confidence. Across all years of study, the response "no change" predominates, with its proportion gradually increasing at more advanced stages of study.

At the same time, a notable proportion of students report a decline in confidence in their professional knowledge and skills. This distribution may reflect the increasing importance of practical training at later stages of the academic trajectory, where the limitations of the face-to-face format may be perceived more acutely (Table 6).

Table 6. Association between confidence in professional knowledge and skills and year of study

Year of Study	Higher Confidence	No Change	Lower Confidence
Year 1	20.5	48.9	21.6
Year 2	19.8	56.6	18.9
Year 3	14.8	54.5	23.9
Year 4	15.7	64.7	11.8
Master's level	19.7	56.8	18.3
Doctoral level	13.3	60.0	26.7

4.2.5. Symptoms of visual strain

The descriptive analysis revealed a high prevalence of symptoms of visual strain among students across all years of study. The proportion of respondents reporting frequent eye fatigue is substantial at all stages of study and shows a tendency to increase among senior students (Table 7).

This distribution is consistent with the assumption of a cumulative nature of physical strain associated with prolonged use of digital devices in the learning process.

Table 7. Frequency of reported symptoms of visual strain by year of study

Year of Study	Frequent Strain	Moderate	Rare
Year 1	47.7	22.7	29.5
Year 2	67.0	16.0	17.0
Year 3	56.8	10.2	33.0
Year 4	70.6	13.7	15.7
Master's level	69.9	13.5	16.6
Doctoral level	60.0	13.3	26.7

The conducted analysis allows for an assessment of the impact of distance learning on students across different years of study under conditions of martial law through the integration of inferential statistical tests and descriptive analysis. The results of the χ^2 tests revealed statistically significant associations between year of study and all key indicators of educational experience, including levels of stress and anxiety, perceived safety and psychological comfort, confidence in professional knowledge and skills, as well as symptoms of visual strain. The effect sizes (Cramér's V ≈ 0.50-0.51) indicate a substantial role of year of study as a structural factor associated with variability in students' distance learning experiences.

At the same time, descriptive statistics demonstrate that this relationship is not uniform across the analyzed indicators. In particular, levels of stress and anxiety exhibit a pronounced year-specific dynamic: at earlier stages of study, greater variability in psycho-emotional responses is observed, whereas at later stages, distance learning is more often perceived as neutral in relation to emotional well-being. This pattern may reflect a gradual process of academic adaptation.

In contrast, perceived safety and psychological comfort remain consistently high regardless of year of study. The vast majority of students report an increased sense of security when studying remotely from home. Accordingly, distance learning may be considered a format that performs a protective function for students in the context of wartime uncertainty.

4.2.6. Alternative Factors of Students' Distance Learning Experience

To examine potential alternative explanations for the variability in students' experiences, the relationship between internally displaced status and key indicators of distance learning was analyzed (Appendix 2). The results of the χ^2 tests did not reveal statistically significant associations with levels of stress and anxiety, confidence in professional knowledge and skills, perceived safety, or the frequency of symptoms of visual strain. Effect sizes remained negligible or small, indicating no meaningful differences in distance learning experiences between displaced and non-displaced students.

Similarly, no statistically significant association was found between year of study and internally displaced status (Appendix 2). This suggests that the differences previously observed across student cohorts are not attributable to an uneven distribution of displaced individuals within the sample. Accordingly, year of study can be considered an independent factor associated with variations in students' experiences.

Additionally, the relationship between the duration of online learning and the examined indicators was analyzed (Appendix 2). Statistically significant, albeit small, associations were identified for levels of stress and anxiety, as well as for the frequency of symptoms of visual strain. This may indicate a limited contribution of academic workload to the development of psycho-emotional and physical fatigue. At the same time, no meaningful associations were found with perceived safety or confidence in professional knowledge.

In summary, the obtained results allow for outlining the relative contribution of factors associated with variability in students' distance learning experiences under conditions of war. Despite the shared context of uncertainty, students do not demonstrate homogeneous responses. The most consistent differences are associated with year of study, highlighting the role of the academic trajectory in structuring educational experiences.

In contrast, internally displaced status did not demonstrate a differentiating effect, while the intensity of online learning was associated only with selected aspects of workload. Overall, these findings point to a multi-level structure of influences: while the macro-context of war sets the general conditions of the educational process, academic factors play a more substantial role in shaping students' experiences than individual or situational characteristics.

Discussion

The scholarly debate on the advantages and disadvantages of the distance learning format has been ongoing since 2020. At that time, it emerged as an emergency response under conditions of global uncertainty and unprecedented social tension caused by the COVID-19 pandemic (Bakhov et al., 2021; Purbudak et al., 2022; Matli & Phurutsi, 2023). However, in comparison with the four-year duration of the war in Ukraine, that period was relatively short.

The most common wave of criticism has concerned the impact on students' physical health. Our findings confirm conclusions from previous studies in this regard. Among Ukrainian students who have been studying online for four years, the most pronounced symptoms are those associated with reduced physical activity and prolonged screen exposure: back and neck pain and visual strain. Sleep quality appears to be affected somewhat less frequently. Similar patterns are widely documented in the literature on online learning during the pandemic (Chu et al., 2022; Zheng et al., 2024; Briones et al., 2023). Our results demonstrate that these risks persist over the long term.

Students themselves identify these issues as the key (and for some, the only) drawback of distance learning. Most respondents evaluate its impact on physical condition as neutral or moderately negative, but not critical. This is likely the result of students' adaptation to the online format over four years. Moreover, a significant proportion of respondents reported maintaining regular physical activity. This, in essence, functions as an effective compensatory strategy; however, it is neither universal nor equally accessible. Not all students are motivated to engage in physical exercise, and not all have the necessary conditions to do so (particularly in terms of safety). This situation points to the need for institutional support of health-preserving practices within universities, as well as broader state or private initiatives that could further motivate young people (for example, discounted gym memberships for students).

The most revealing findings concern students' mental health. Unlike the pandemic period, when the abrupt transition to distance learning was accompanied by a sharp increase in anxiety, depressive symptoms, and feelings of social isolation (Tarawneh et al., 2024; Othman et al., 2025), our results indicate that the distance learning format does not act as a dominant factor of psychological distress. On the contrary, it appears to perform a stabilizing function. The opportunity to study at home, in a familiar environment and close to family, significantly reduces psycho-emotional strain that might otherwise arise when staying on campus under conditions of missile attacks and constant danger. A limited body of research on education in emergencies emphasizes the role of distance learning as a

mechanism for maintaining a sense of “normality” and continuity of life (Nicolai, 2009; Mitchell et al., 2020).

The fact that nearly half of respondents reported no change in stress levels compared to traditional learning, and more than a quarter even experienced a decrease, can be interpreted as the result of several interrelated processes. First, distance learning has ceased to be a new or emergency format; it has become a “normalized” educational practice. Universities and students have adapted technologically, methodologically, and psychologically. Second, under wartime conditions, the primary sources of stress are existential threats related to physical safety, uncertainty about the future, displacement, and loss of home. Difficulties associated with distance learning are therefore perceived as less significant stressors. Even widespread technical problems or power outages, mentioned by some respondents, are not viewed as critical.

The finding that students experience a greater sense of safety and psychological comfort when studying remotely from home than when attending campus is one of the central results of this study. Wartime conditions fundamentally reshape the hierarchy of needs: the basic need for safety becomes decisive for any form of activity. In this context, distance learning remains the only format that preserves access to education when face-to-face learning may be dangerous or impossible due to displacement, including relocation abroad. Students associate distance learning not only rationally but also emotionally with a sense of control, predictability, and, consequently, reduced anxiety.

Despite the widespread emphasis in the literature on social isolation in distance learning environments (Clemente-Suárez et al., 2021; Liu & Lin, 2024; Martins et al., 2025), our findings do not support its universality. For most respondents, the level of informal communication has either not deteriorated or is not perceived as critical. Many students reported maintaining active communication with peers through digital channels. Even those who are internally displaced have often established new social connections beyond the university environment and therefore do not experience a deficit in informal interaction. Thus, distance learning does not eliminate social interaction for those who need it but rather transforms its forms.

An important finding of the study is the absence of widespread concern among students regarding the quality of their professional training. Assumptions about a potential decline in professional preparation in distance learning conditions (Albanyan, 2024; Zazymko et al., 2025) are not supported by the evaluations of the students we surveyed. Most respondents not only do not perceive distance learning as a threat to their career prospects but, on the contrary, consider it more convenient and effective. In particular, this is due to schedule flexibility, the possibility of combining studies with professional work, savings in time and resources for commuting, and overall domestic convenience. According to respondents, these advantages provide more time and opportunities to engage with their profession in comfortable conditions than in a traditional offline format.

Inferential analysis provided additional insights, showing that students’ perceptions of distance learning are not homogeneous but vary depending on the stage of study. The identified differences across several indicators suggest that the experience of distance learning is shaped not only by the format itself but also by students’ level of academic maturity. In other words, distance learning cannot be treated as a uniformly experienced educational condition – its impact evolves alongside students’ experience and their degree of adaptation to the educational environment.

One possible explanation is that students at different stages possess different levels of self-regulation and capacity to cope with academic demands. More experienced students

tend to be more productive in a distance learning format, better able to manage their time, and more resilient to challenges. Accordingly, they are more likely to perceive distance learning as comfortable and manageable compared to first-year students.

At the same time, the absence of significant differences between students with different displacement statuses suggests that the experience of distance learning under wartime conditions is, to some extent, leveled. The prolonged exposure to crisis factors may contribute to the development of shared adaptive strategies regardless of individual life circumstances. This may reflect a broader process of collective adaptation within the student population to wartime conditions.

Thus, the findings of this study demonstrate that distance learning in wartime conditions is not a unidimensional risk factor for students' health. While it is indeed associated with certain physical challenges, it also performs important protective functions for mental health, provides a sense of safety, and supports professional development. In this sense, distance education can be reconsidered not as a "lesser evil," but as a context-dependent format capable of sustaining student resilience in situations of prolonged social instability.

Conclusion

This study examined students' subjective perceptions of the impact of distance learning on their physical and mental health, social interaction, and professional training in the context of prolonged wartime instability. The findings suggest that distance learning should not be interpreted as an unequivocally negative or positive phenomenon; rather, its impact appears multidimensional and dependent on both individual and contextual factors.

Prolonged engagement in distance learning is associated with certain risks to students' physical health, primarily symptoms related to sedentary behavior and extended screen exposure, including musculoskeletal discomfort, visual strain, and sleep disturbances. However, these effects were generally evaluated by students as moderate. Regular physical activity was associated with fewer complaints of physical discomfort, indicating its protective role in the context of sustained distance learning and underscoring the importance of supporting health-preserving practices at the institutional level in higher education.

A key contribution of the study lies in identifying the structural heterogeneity of students' experiences. Inferential analysis demonstrated that perceptions of distance learning vary significantly across different stages of academic progression, suggesting that academic maturity functions as an important mediating factor.

Contrary to concerns frequently expressed in post-pandemic literature, distance learning under wartime conditions did not emerge as a dominant factor in the deterioration of mental health. Rather, students' evaluations appear embedded within a broader hierarchy of stressors, in which security-related threats and societal instability outweigh the influence of the educational format. Under such conditions, the opportunity to study remotely from a familiar and relatively safer environment may serve a stabilizing and psychologically protective function.

Importantly, the majority of respondents did not associate distance learning with a decline in the quality of their professional training. On the contrary, many students reported confidence in their knowledge and skills, emphasizing advantages such as schedule flexibility, efficient time use, and the ability to combine studies with work. These findings challenge widespread assumptions regarding the inevitable decline of professional competencies in distance learning contexts.

Taken together, the results support the interpretation of distance learning in crisis conditions not merely as an emergency educational solution, but as a complex socio-educational environment capable of restructuring students' priorities, their perceptions of well-being, and their adaptive strategies. In the context of wartime Ukraine, distance learning appears to function not only as a mechanism for ensuring educational continuity but also as a resource that may contribute to student resilience, provided that appropriate organizational and institutional support is in place.

Limitation

Several limitations should be considered when interpreting the results of this study.

First, the sample was drawn from a single Ukrainian university that operated predominantly in a distance learning format during the war. While this context provides valuable insights into higher education under conditions of prolonged societal disruption, the findings should be interpreted with caution when considering broader student populations, as institutional practices, regional security conditions, and access to campus-based learning vary across universities.

Second, the study relied on students' self-reported assessments of physical well-being, psychological state, and educational experience. Such measures capture subjective perceptions rather than clinically validated health indicators and may therefore be influenced by response biases or individual differences in self-evaluation.

Third, the cross-sectional design of the data limits the ability to capture the dynamic nature of students' adaptation to distance learning over time. Students' experiences may evolve alongside changes in both educational formats and crisis conditions, highlighting the value of longitudinal approaches in future research.

Finally, although the study identified several statistically significant associations, additional variables – including prior experience with online learning, field of study, intensity of digital interaction, and individual resilience factors – may further explain variations in students' perceptions and warrant deeper analytical attention.

Future research could benefit from multi-institutional designs, the inclusion of validated measurement instruments, and comparative analyses across diverse educational and geopolitical contexts to achieve a more comprehensive understanding of distance learning under conditions of instability.

Ethics Statement

Ethical approval for the study was obtained from the Ethics Committee of Berdyansk State Pedagogical University (Protocol No. 4.9/2025, September 16, 2025). The study was conducted in accordance with the principles of the 1964 Declaration of Helsinki and its subsequent amendments. All participants provided informed consent prior to participation. They were fully informed about the purpose of the study and assured of the anonymity and confidentiality of their data. Participants were also informed that their responses would be used solely for research purposes and presented in aggregated form for publication. They retained the right to withdraw their consent to participate at any time without any consequences.

Declaration of interests

Authors declare no competing interests.

Data availability

The datasets generated and analyzed during the current study, as well as the survey instrument and supporting materials, are available in the Zenodo repository at https://doi.org/10.5281/zenodo.19761392.

References

Alarabiat, A. (2024). The Impact of Online Learning Fatigue on Students` Continuous use of Online Learning. *Journal of Theoretical and Applied Information Technology*, 102(20), 7423-7439. https://jatit.org/volumes/Vol102No20/13Vol102No20.pdf

Albanyan, A.M. (2024). The quality of distance learning during COVID-19: Perspectives of Saudi university students. *Heliyon*, 10(13), e33731. https://doi.org/10.1016/j.heliyon.2024.e33731

Alkhawashki, S. H., AlTuwairqi, M. H., Almadani, A. H., Almarshedi, A. A., Alasiri, R., Mobeireek, N. A., Alrashoud, M. R., Abouammoh, N. A., Alshahrani, F. S., AlFattani, A. A., et al. (2024). Psychological Impact of Distance Learning on Children and Adolescents in Saudi Arabia: A Multi-City Analysis of Behavioral and Mental Health Outcomes During the COVID-19 Pandemic. *Children*, 11, 1551. https://doi.org/10.3390/children11121551

Bakhov, I., Opolska, N., Bogus, M., Anishchenko, V., & Biryukova, Y. (2021). Emergency Distance Education in the Conditions of COVID-19 Pandemic: Experience of Ukrainian Universities. *Education Sciences*, 11(7), 364. https://doi.org/10.3390/educsci11070364

Briones, S. M. D., Eje, C. J., Garingalao, A. D. N. E., Mariano, J. P., H. M. & Espanola M. S. (2023). Virtual Fatigue: Exploring Challenges Experienced by Students in the Online Classroom During the Pandemic. *International Journal of Early Childhood Special Education*, 15(5), 244-253. https://doi.org/10.48047/INTJECSE/V15I5.30

Chu, Y.-H. & Li, Y.-C. (2022). The Impact of Online Learning on Physical and Mental Health in University Students during the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, 19, 2966. https://doi.org/10.3390/ijerph19052966

Clemente-Suárez, V. J., Navarro-Jiménez, E., Jimenez, M., Hormeño-Holgado, A., Martinez-Gonzalez, M. B., Benitez-Agudelo, J. C., Perez-Palencia, N., Laborde-Cárdenas, C. C., & Tornero-Aguilera, J. F. (2021). Impact of COVID-19 Pandemic in Public Mental Health: An Extensive Narrative Review. *Sustainability*, 13(6), 3221. https://doi.org/10.3390/su13063221

Culduz, M. (2024). Benefits and Challenges of E-Learning, Online Education, and Distance Learning. *Incorporating the Human Element in Online Teaching and Learning*, 1-27. https://doi.org/10.4018/979-8-3693-4131-5.ch001

Długosz, P.; Liszka, D.; Bastrakova, A. & Yuzva, L. (2022). Health Problems of Students during Distance Learning in Central and Eastern Europe: A Cross-Sectional Study of Poland and Ukraine. *International Journal of Environmental Research and Public Health*, 19(16), 1-16. https://doi.org/10.3390/ijerph191610074

El-Sbahi, H., Lowe, W., & Morris, C. (2024). How can we use distance education to teach medicine in conflict-affected countries? *Medicine, Conflict and Survival*, 40(4), 388–418. https://doi.org/10.1080/13623699.2024.2392071

Ghanad, A. (2023). An Overview of Quantitative Research Methods. *International Journal Of Multidisciplinary Research And Analysis*, 06(08). 3794-3803. https://doi.org/10.47191/ijmra/v6-i8-52

Hanon, M. (2022). Access to education in conflict crises: The impact of education in emergencies interventions in armed conflict (Master's thesis). Department of Peace and Conflict Research, Uppsala University. 76 p.

Husini, R., Lenskiy, A. & Lee, J.-S. (2010). Distance learning and fatigue monitoring. In Proceedings of the International Forum on Strategic Technology (Ulsan, Republic of Korea, 13–15 October 2010); IEEE: Piscataway, NJ, USA, pp. 95–97. https://doi.org/10.1109/IFOST.2010.5667915

Inan, F. A., Unal, D., Marzban, F., Sosi, E. T., & Bayne, G. A. (2025). The Impact of Health Status, Chronic Conditions, and Mental Fatigue on College Students' Grade Expectations in Online Courses. *European Journal of Investigation in Health, Psychology and Education,* 15(7), 118. https://doi.org/10.3390/ejihpe15070118

Lischer, S., Safi, N. & Dickson, C.(2021). Remote learning and students' mental health during the Covid-19 pandemic: A mixed-method enquiry. *Prospects*, 51, 589-599. https://doi.org/10.1007/s11125-020-09530-w

Liu, Q., Lin, D. (2024). The impact of distance education on the socialization of college students in the Covid-19 era: problems in communication and impact on mental health. *BMC Medical Education*, 24, 575. https://doi.org/10.1186/s12909-024-05551-7

Martins, T.B., Branco J.H.L., Santos, G.M. & Andrade, A. (2025). Impact of social isolation during the COVID-19 pandemic on the mental health of university students and recommendations for the post-pandemic period: A systematic review. *Brain, Behavior, & Immunity – Health*, 43, 100941. https://doi.org/10.1016/j.bbih.2024.100941

Matli, W. & Phurutsi, M. (2023). Students' concerns about Online Remote Learning during COVID-19 Pandemic in the 4IR digital society. *Procedia Computer Science*, 219, 971-976. https://doi.org/10.1016/j.procs.2023.01.374

Mitchell, J., Ashlee, A., Clericetti, G., Gladwell, J. & Torrance, R. (2020). Education in Emergencies: A Rapid Evidence Review. 47 p. https://doi.org/10.5281/zenodo.DOI%2010.5281/zenodo.4556940

Nicolai, S. (2009) Opportunities for change. Education innovation and reform during and after conflict. UNESCO IIEP. 262 p. https://unesdoc.unesco.org/ark:/48223/pf0000183808

Noskova, M., Svistelnyk, I., Kovtun, I., Zhyglo, O. & Venhrin, M. (2024). The impact of distance education on the mental health of applicants for education: the role of digital psychological support. *AD ALTA Journal of Interdisciplinary Research*, 14(1), 157-162. https://doi.org/10.33543/j.140141.157162

Othman, M. B. & Mohamed Yasin, R. A. (2025). The impact of remote learning on student's mental health at institut kemahiran tinggi perda. *Asian People Journal*, 8(SI1), 312-324. http://dx.doi.org/10.37231/apj.2025.8.SI1.825

Pilcher, N. & Cortazzi, M. (2024). 'Qualitative' and 'quantitative' methods and approaches across subject fields: implications for research values, assumptions, and practices. *Quality & Quantity*, 58, 2357-2387. https://doi.org/10.1007/s11135-023-01734-4

Pohorilyak, R. Yu., Zheliznyak, A. V. & Feger, O. V. (2023). Impact of distance education on students' health. *Wiadomości Lekarskie Medical Advances*, 76(3), 640-644. https://doi.org/10.36740/WLek202303129

Purbudak, A., Yilmaz, M. & Cakir, O. (2022). Emergency distance education during the COVID-19 pandemic: a qualitative research from a special education perspective. *Turkish Online Journal of Distance Education*. 23(3). 86-102. https://doi.org/10.17718/tojde.1137208

Rezapour, M. & Elmshaeuser, S. K. (2022). Artificial intelligence-based analytics for impacts of COVID-19 and online learning on college students' mental health. *PLoS ONE*, 17(11): e0276767. https://doi.org/10.1371/journal.pone.0276767

Sharma, D. (2025). The Effects of Online Learning on Students' Health and Academic Performance in High Education Institutions. *International Journal for Research Trends in Social Science & Humanities*, 3(2), 932-942 https://doi.org/10.61463/ijrtssh.vol.3.issue2.151

Tarawneh, D., Al Sawalqa, H. A., Al-Adayleh, M., Dahabreh, S. M. & Isawi, H. (2024). The impacts of mental health and psychological wellbeing on students' performance during distance learning; Lessons learnt from the COVID-19 lockdown in Jordan. *Journal of Accessibility and Design for All*, 14(1), 69-84. https://doi.org/10.17411/jacces.v14i1.374

Unnisa, V. (2025). Impact of Technology and Online Learning on Physical Health of Students. *Research review International Journal of Multidisciplinary*, 6(7), 89-97. https://doi.org/10.31305/rrijm.2021.v06.i07.015

Wallwey, C. & Kajfez, R. (2023). Quantitative research artifacts as qualitative data collection techniques in a mixed methods research study. *Methods in Psychology*, 8, 100115. https://doi.org/10.1016/j.metip.2023.100115

Zazymko, O., Klikh, L. & Nazarenko, V. (2025). Improving the quality of higher technological education by overcoming educational losses. *Educational Dimension*, 13, pp.126–140. https://doi.org/10.55056/ed.979

Zhao, L., Hwang, W.-Y., & Shih, T. K. (2021). Investigation of the Physical Learning Environment of Distance Learning Under COVID-19 and Its Influence on Students' Health and Learning Satisfaction. *International Journal of Distance Education Technologies*, 19(2), 77-98. https://psycnet.apa.org/doi/10.4018/IJDET.20210401.oa4

Zheng, D.-D., Li, D., Cheng, J.-X. & Jin, R.-H. (2024). The prevalence of neck pain among onlinelearning students: An observational study. *Medicine*, 103(32), 1-6. https://doi.org/10.1097/MD.0000000000039264

Zhytova, O. & Butuzova, L. (2023). Psychoemotional health of students in distance learning conditions. Europejskie studia humanistyczne: Państwo i Społeczeństwo, 1, 41-55. https://doi.org/10.38014/ehs-ss.2023.1.03

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Appendix1.docx
- Appendix2.docx