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## Interactive methods of online teaching of pathological anatomy for international students: psychological and cultural aspects in conditions of war and pandemic

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This article provides an overview and comparative analysis of modern approaches to distance teaching of pathological anatomy to international students in medical universities in Ukraine and Europe under conditions of war and pandemic.

**Aim** – to analyze and summarize the experience of applying interactive online methods for teaching pathological anatomy to international students in the context of martial law and the pandemic, with a focus on the psychological and cultural aspects of the educational process.

Psychological, cultural, and didactic aspects of the organization of the educational process are examined, as well as features of adapting educational materials and implementing interactive technologies in a distance learning environment. Effective strategies for using multimedia tools, online platforms, and visualization methods to improve the quality of morphological knowledge acquisition are identified. Special attention is paid to intercultural communication, support for academic motivation, and social integration of international students.

The results indicate that interactive forms of online learning, focused on interpersonal interaction and individual student needs, contribute to increased learning efficiency and the formation of a positive educational experience.

Authors declare no conflict of interest.

**Keywords:** online learning, pathological anatomy, international students, interactive methods, psychological support, distance education.

### Інтерактивні методи онлайн-навчання патологічної анатомії для іноземних студентів: психологічні та культурні аспекти в умовах війни та пандемії

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Здійснено огляд і порівняльний аналіз сучасних підходів до дистанційного викладання патологічної анатомії іноземним студентам у медичних університетах України та Європи в умовах війни та пандемії.

**Мета** – аналіз та узагальнення досвіду застосування інтерактивних онлайн-методів викладання патологічної анатомії іноземним студентам в умовах війни та пандемії із приділенням особливої уваги психологічним та культурним аспектам освітнього процесу.

Розглянуто психологічні, культурні та дидактичні аспекти організації навчального процесу, особливості адаптації навчальних матеріалів і впровадження інтерактивних технологій у дистанційне середовище. Визначено ефективні стратегії використання мультимедійних засобів, онлайн-платформ і методів візуалізації для підвищення якості засвоєння морфологічних знань. Особливу увагу приділено питанням міжкультурної комунікації, підтримки академічної мотивації та соціальної інтеграції іноземних студентів.

Отримані результати свідчать, що інтерактивні форми онлайн-навчання, орієнтовані на міжособистісну взаємодію та індивідуальні потреби студентів, сприяють підвищенню ефективності навчання та формуванню позитивного освітнього досвіду.

Автори заявляють про відсутність конфлікту інтересів.

**Ключові слова:** онлайн-навчання, патологічна анатомія, іноземні студенти, інтерактивні методи, психологічна підтримка, дистанційна освіта.

## Introduction

In the context of global challenges, such as the COVID-19 pandemic and the war in Ukraine, educational systems have undergone significant transformations affecting both the organization and the content of the learning process. This is particularly relevant for medical disciplines, especially pathological anatomy, which traditionally rely heavily on practical classes requiring the direct presence of students in laboratories and hands-on work with microscopic specimens.

The shift to distance learning became a necessity, demanding rapid adaptation from both instructors and students. This process was accompanied by the

search for effective online tools, digital platforms, and methods for visualizing morphological structures that could ensure an adequate level of knowledge acquisition without compromising the quality of training future physicians.

Special attention in this context is warranted for international students, who traditionally constitute a significant portion of the student body in Ukrainian medical universities. For many of them, Ukraine has long been an attractive educational center due to the high quality of medical education and the affordable cost of tuition. However, the security situation caused by military actions has led to a decrease in the number of international students and necessitated the development of new approaches to

distance learning for those who continue their studies outside Ukraine.

There is a need not only to improve the content of educational materials in English but also to create flexible, interactive learning environments that take into account the cultural, linguistic, and temporal characteristics of students from different countries. Thus, contemporary challenges are stimulating Ukrainian medical institutions to pursue innovations aimed at supporting academic mobility, maintaining educational quality, and integrating into the global educational space even under crisis conditions.

The *aim* of this article is to analyze and summarize the experience of applying interactive online methods for teaching pathological anatomy to international students in the context of martial law and the pandemic, with a focus on the psychological and cultural aspects of the educational process.

The study is aimed at identifying effective pedagogical strategies that contribute to improving the quality of education, helping students adapt to new learning conditions, and fostering an inclusive and intercultural learning environment.

The study has a review-analytical character and is based on the study and comparison of modern approaches to distance teaching of pathological anatomy to international students in medical universities in Ukraine and abroad. The materials analyzed included scientific publications from international databases, educational and methodological documents, statistical reports from international organizations, and the authors' own observations of the educational process from 2022 to 2025. Analytical, comparative, content, and system-structural methods were applied, as well as a generalization of pedagogical experience in online teaching. The analysis was conducted according to the criteria of digital resource accessibility, interactivity of the educational process, adaptation of materials to the needs of international students, and their level of engagement in learning.

The COVID-19 pandemic and the full-scale war in Ukraine have triggered significant changes in the education system, particularly in the field of medical training. Temporary closures of educational institutions during the pandemic substantially complicated the organization of the learning process, especially for disciplines requiring hands-on practice, such as pathological anatomy. According to UNESCO, more than 6.4 million students in Ukraine experienced

interruptions in their studies due to the pandemic and war, and a significant portion of educational institutions were damaged or destroyed during military actions [10].

The war has also profoundly affected Ukraine's international educational landscape. According to the Ukrainian State Center for International Education, while over 84,000 international students were enrolled in Ukrainian higher education institutions in 2022, by 2024, this number had decreased to approximately 34,000 [9]. Educational analysts estimate that more than 60,000 international students left Ukraine after the outbreak of war, continuing their studies remotely from abroad [8]. Only about 15% of international students continue to study directly in Ukraine, whereas the majority have adopted distance learning formats, posing a new challenge for medical universities in maintaining high-quality practical training [9].

Under the restrictions imposed by the pandemic and war, online learning has become a key tool to ensure the continuity of education in medical universities. Interactive methods, including the use of virtual laboratories, 3D models, and simulations, have allowed students to study complex morphological structures without the need for physical presence in classrooms or laboratories [1,3–5].

Modern online communication platforms such as Zoom, Google Meet, and Moodle are actively used for conducting lectures, seminars, and practical classes in real time. Specifically, Google Meet enables interactive group discussions, screen sharing for the demonstration of microscopic images, and provides stable video communication even under conditions of unstable internet connectivity [4,7].

To support active student engagement, a wide range of interactive assessment tools, such as Kahoot!, Quizizz, Mentimeter, and Google Forms, are employed. These tools allow for the creation of tests, surveys, and short quizzes, which not only assess knowledge acquisition but also stimulate critical thinking and promote teamwork during lessons.

It is also important to highlight the development of digital resources for studying histology and pathological anatomy. Online virtual slide databases, such as Virtual Microscope, PathPresenter, or university educational platforms (e.g., HistologyGuide.com), allow students to explore high-resolution images of tissue specimens, zoom in, analyze fine details, and compare pathological changes [1,4,12]. This significantly enhances the effectiveness of dis-

Table

**Recommendations for enhancing the effectiveness of online teaching of pathological anatomy for international students**

No.	Direction / area	Recommendations	Examples / Tools	Expected effect for students	Possible implementation challenges
1	Adaptation of Educational Materials	Development of multimedia resources considering linguistic and cultural features	Video lectures, interactive presentations, animations	Improved understanding of complex topics, increased engagement	Time and resources required for content creation
2	Interactivity of Classes	Use of interactive tests and quizzes	Kahoot!, Quizizz, Mentimeter, Google Forms	Active participation, stimulation of critical thinking	Need for technical preparation and task adaptation
3	Online Platforms	Conducting lectures, seminars, and practical classes in real-time	Zoom, Google Meet, Moodle	Support for feedback, interactivity	Unstable internet, different student time zones
4	Virtual Laboratories	Access to digital histology collections and simulations	Virtual Microscope, PathPresenter, HistologyGuide.com	Development of practical skills, exploration of microscopic structures	Possible technical limitations for students
5	Museum Collections	Integration of digital images of museum pathological specimens	Online anatomy and pathology museums, 3D scans of exhibits	Better visualization of pathological changes, linking theory to practice	Limited availability of high-quality images
6	Psychological Support	Consultations and mentoring programs to reduce stress and improve adaptation	Online consultations, senior student support, support groups	Improved emotional state, increased motivation	Not all students actively use the support
7	Technical Support	Ensuring stable access to the internet and digital platforms	High-speed internet, technical assistance, user guides	Reduced technical barriers, uninterrupted learning process	Limited access to equipment for some students
8	International Collaboration	Expanding experience exchange and involving students in joint projects	Exchange programs, joint research, online seminars with international instructors	Integration into the global educational space, development of collaboration skills	Differences in curricula and language barriers
9	Social Interaction	Creating online communities for experience sharing and mutual support	Google Classroom, WhatsApp groups, student forums	Increased engagement, development of communication skills	Requires regular moderation

tance learning, providing a format that closely approximates the real laboratory experience.

Thus, the integration of digital technologies into the educational process has not only compensated for the limitations caused by the pandemic and war but has also acted as a catalyst for innovation in medical education, promoting the development of more flexible, inclusive, and technologically advanced approaches to training future physicians [3–5].

Online learning requires students to maintain a high level of self-discipline, motivation, and organizational skills, as success in mastering the material largely depends on individual responsibility and the ability to manage time effectively. For international medical students in Ukraine, these requirements are accompanied by several specific challenges. These include language barriers, limited understanding of professional terminology, cultural differences in perceiving the learning process, and a psychological

sense of isolation from the academic and social environment. The lack of direct contact with instructors, which is particularly important in clinically oriented disciplines, can reduce student engagement and affect communication quality [8].

Practical experience shows that the effectiveness of online learning for international students is significantly increased when additional communication tools are implemented (e.g., Google Classroom, WhatsApp channels for group discussions), lecture recordings with English subtitles are provided, and individual consultations are conducted via Google Meet or Zoom. An essential support element is also the creation of online student communities where they can share experiences, ask questions, and receive assistance from instructors and peers. The application of these practices not only enhances academic performance but also positively affects the emotional state and social integration of international students, reducing stress

and feelings of isolation during learning in wartime conditions [3,6].

To improve the effectiveness of online learning for international students in Ukrainian higher education institutions, it is advisable to implement comprehensive measures (Table) aimed at enhancing the content, technical, and socio-psychological components of the educational process [4,6,7]. A primary step is the adaptation of educational materials, which involves the development of multimedia resources – video lectures, interactive tests, educational presentations, and animations, taking into account the linguistic and cultural characteristics of students [3,4]. This not only improves the understanding of complex topics but also increases student engagement in learning.

It is also crucial to ensure a support system for students, including regular online consultations with instructors, mentoring programs involving senior students or graduates, as well as psychological assistance aimed at overcoming stress, isolation, and cultural adaptation [8]. Another important aspect is improving the technical infrastructure, which encompasses ensuring stable access to high-speed internet, creating user-friendly digital learning platforms, and providing technical support for students with limited access to modern devices.

Furthermore, the development of international collaboration plays a significant role, including expanding academic exchange programs, participating in joint research and projects, and sharing experiences among instructors from different universities, which facilitates the integration of international students into the global educational space. Comprehensive implementation of these recommendations can not only improve the quality of the educational process but also contribute to the creation of an inclusive, comfortable, and effective learning environment for all participants.

## Conclusion

Online teaching of pathological anatomy for international students in Ukraine during the COVID-19 pandemic and the war has proven to be an important tool for ensuring the continuity of medical education. Distance learning formats allow the academic process to be maintained even when students have limited access to classrooms and laboratories. At the same time, the effectiveness of such learning largely depends on considering the psychological, cultural, and linguistic aspects that influence student motivation and academic outcomes. The main challenges remain the lack of direct contact with instructors and peers, language barriers, cultural differences, and technical issues such as unstable internet connections and limited access to digital resources and virtual histology specimens. However, the integration of multimedia resources, the use of modern platforms (Zoom, Google Meet, Moodle), and the provision of online consultations and mentoring programs significantly increase student engagement, support their psychological adaptation, and ensure the interactivity of learning. A comprehensive approach that combines adaptation of educational materials, technical support, and organizational measures not only improves academic outcomes but also enhances the socio-psychological well-being of students. Expanding international collaboration, sharing experiences among instructors, and involving students in joint projects create additional opportunities for integrating international students into the global educational space. Thus, effective online learning requires a combination of technological, methodological, and psychological strategies, ensuring the resilience of the educational process and maintaining a high level of medical training even under crisis conditions.

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