PROFESSIONAL DEVELOPMENT OF ACADEMIC STAFF AT MEDICAL HIGHER EDUCATION INSTITUTIONS TO OPTIMIZE THE TEACHING OF THE MORPHOLOGICAL DISCIPLINE "HISTOLOGY, CYTOLOGY, EMBRYOLOGY" UNDER BLENDED LEARNING CONDITIONS

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ABSTRACT

Background. Higher medical education in Ukraine is undergoing a technological transformation that requires the development of blended learning and the optimization of teaching morphological disciplines. Ensuring the quality of training for future healthcare professionals requires that academic staff systematically improve their computer literacy and digital pedagogical competence, as well as implement innovative tools.

Aim. To substantiate the practical significance of improving the digital-pedagogical qualifications of academic staff at medical higher education institutions as a factor in modernizing the educational process, improving visualization and student comprehension, and enhancing the quality of mastering the discipline "Histology, Cytology, Embryology" under blended learning conditions.

Materials and Methods. Practical experience gained during the professional development course "Theory and Practice of Distance Learning" (150 hours), organized by the Institute for Advanced Training of Pharmacy Specialists at the National University of Pharmacy from November 25, 2025, to December 23, 2025, was analyzed. The study was conducted as a private initiative of the author, without grant support or state registration of the research topic.

Research Ethics. The study was conducted in compliance with international and national standards of bioethics and academic integrity. The study did not involve human participants or personal data. The Biomedical Ethics Committee of Bukovinian State Medical University (Protocol No.5 of February 19, 2026) found no ethical violations.

Results. In accordance with the issued certificate, the following Learning Outcomes (LO) were achieved: LO 05, implement information and communication technologies in teaching and develop distance-learning courses; LO 07, master effective communication methods; and LO 09, define goals and criteria, select tools, and develop assessment methods and technologies according to the specifics of the educational component.

Conclusions. The course enabled the achievement of program learning outcomes in digital content design and organization of interactive assessment in Moodle. Integrating the acquired competencies into the teaching of "Histology, Cytology, Embryology" will enable the creation of a blended learning model: preliminary analysis of histological specimens and digital atlases online rationalizes classroom time for practicing light microscopy skills.

Keywords: *teaching issues, theoretical medicine, computer literacy.*

Abbreviations

3D – Three-Dimensional.
AI – Artificial Intelligence.
ECTS – European Credit Transfer and Accumulation System.
H5P – HTML5 Package.
HEI – Higher Education Institution.
LMS – Learning Management System.
LO – Learning Outcome.
MCQ – Multiple-Choice Question.
NUPh – National University of Pharmacy.
VR – Virtual Reality.

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Introduction

At the current stage of development, higher medical education in Ukraine is undergoing a profound technological transformation and adapting to contemporary challenges [1–4], including the

implementation of blended learning. This format combines traditional classroom instruction with synchronous and asynchronous learning environments. This, in turn, requires a high level of computer literacy and digital pedagogical competence among academic staff [5]. In this context, continuous professional development of academic staff at medical HEIs is a strategic prerequisite for ensuring the quality of training future healthcare professionals.

This issue is particularly important in teaching fundamental morphological disciplines, specifically "Histology, Cytology, Embryology" [6]. The discipline requires the development of visual-spatial thinking in higher education students, an understanding of the macro- and microstructure of the human body, and practical light-microscopy skills for differentiating cells, tissues, and organs in histological specimens. Traditionally, this process has relied on hands-on work with light microscopes in the classroom. Under blended learning conditions, instructors face greater challenges in maintaining students' attention and interactivity during remote learning; therefore, theoretical blocks (lectures, video materials, MCQs) must be combined with intensive face-to-face practical sessions.

Optimizing the teaching of histology, cytology, and embryology under these conditions is impossible without targeted professional development of academic staff in digital pedagogy. Such training helps address contemporary challenges by implementing innovative tools. Educators learn to integrate digital atlases [7], 3D reconstructions [8], AI [9], and VR. Instructors also master gamification and interactive assessment tools to create situational morphological cases and interactive diagrams, which may enhance the motivation of first-year students.

Thus, professional development of academic staff is not merely a formal requirement; it is an important component of optimizing the educational process in "Histology, Cytology, Embryology". This approach can transform traditional departmental teaching methods into a technologically advanced, flexible learning system that preserves the fundamental nature of medical knowledge while aligning with the demands of contemporary digital education.

The aim of this study was to substantiate the practical significance of improving the digital-pedagogical qualifications of academic staff at medical higher education institutions as a factor in modernizing the educational process, enhancing visualization and student comprehension, and improving the quality of mastering the discipline "Histology, Cytology, Embryology" under blended learning conditions.

Materials and Methods

Practical experience was gained through the professional development course "Theory and Practice of Distance Learning" (150 hours/5 ECTS credits), organized by the Institute for Advanced Training of Pharmacy Specialists at the National University of Pharmacy from November 25, 2025, to December 23, 2025. The course curriculum included the following key topics: "Regulatory requirements for creating distance learning courses at NUPh"; "LMS Moodle: distance learning course interface (resources, activities)"; "Competency-based approach in LMS Moodle"; "Effective distance learning methodologies"; "Creating quizzes and configuring the assessment system in LMS Moodle"; "Tools for organizing video-based classes"; "Visual design in distance education"; "Multimedia content development. Requirements for presentations"; "Online tools for interactive engagement"; and "Modern psychological techniques for supporting distance learning courses".

The competencies and methodological materials acquired during the course served as the basis for modernizing the educational process at the Department of Histology, Cytology and Embryology of Bukovinian State Medical University. The study employed a practitioner-oriented pedagogical research design conducted as a part of the author's professional development course "Theory and Practice of Distance Learning". To achieve the objective, a comprehensive set of scientific and pedagogical methods was applied: analysis was used to review the regulatory framework, educational curricula, and instructional materials of the courses; comparative analysis served to evaluate traditional versus digital teaching formats, as well as various LMS platforms and tools; generalization was applied for the final synthesis of the acquired knowledge and systematic structuring of learning outcomes; modeling was utilized to construct a conceptual model for a distance learning course, taking into account the specifics of the discipline; and pedagogical projection was used to directly design the structure of e-learning content, methodological support, interactive assignments, and assessment algorithms.

Research Ethics

The study was conducted in compliance with internationally recognized standards and national regulations on bioethics and academic integrity. The study did not involve human participants or

personal data. The Biomedical Ethics Committee of Bukovinian State Medical University (Protocol No.5 of February 19, 2026) found no violations of moral or legal standards during the course of this research work.

Results

The professional development course "Theory and Practice of Distance Learning" comprised lectures, practical sessions, and homework assignments designed to consolidate theoretical knowledge and practical skills. During the course, flowcharts for educational sessions were created to improve visualization using Miro, Draw.io, and Lucidchart. Interactive videos were designed using the H5P plugin integrated into the Moodle LMS. Canva was used to create and animate the course logo. To foster critical thinking, the Cinquain method was implemented in the Moodle LMS Forum module and Miro.

Furthermore, scribing, an innovative educational technology, was used to visualize content through the synchronous illustration of narratives with simple drawings, diagrams, arrows, and keywords. Gamified educational platforms, specifically Wordwall and LearningApps, were used to incorporate crosswords into the learning process. To facilitate real-time online collaboration between students and instructors, interactive annotation skills were practiced on the virtual whiteboard Padlet. On this platform, the instructor published tasks, and learners, individually or in groups, attached their answers, diagrams, and comments directly to the board. The course also included other forms of educational work.

The primary outcome of completing this professional development course was the formation of an updated professional profile for an instructor of a morphological discipline. According to the professional development certificate, the following LOs were achieved:

LO 01. Understand the rules and organizational forms of the educational process in HEIs; the requirements of the internal quality assurance system and the HEI development strategy; and conduct professional activities accordingly.

LO 02. Understand the methodology of analyzing, evaluating, and synthesizing information; search for, process, and analyze professionally relevant knowledge from various sources using modern information and communication technologies.

LO 03. Understand the requirements for the structure and content of an educational component syllabus (working curriculum), as well as the requirements and approaches for developing teaching and methodological materials, and create methodological support for the educational process.

LO 04. Understand modern teaching methods and technologies applicable to the respective educational component; analyze and improve personal teaching methods.

LO 05. Implement information and communication technologies to support learning and the development of distance-learning courses.

LO 06. Teach using modern and effective instructional methods and technologies.

LO 07. Understand and master methods and techniques of effective communication.

LO 08. Understand the methods and rules of maintaining academic integrity; foster ethical and socially responsible behavior in higher education students; and monitor students' compliance with academic integrity requirements and rules during learning-outcome assessment.

LO 09. Understand and define goals and criteria, select tools, and develop methods and technologies to assess learning outcomes tailored to the specifics of the educational component and its constituents.

LO 10. Understand Benjamin Bloom's taxonomy and use it to analyze the learning outcomes of an educational component or its constituents based on student assessment results.

The main practical outcome of completing the professional development course "Theory and Practice of Distance Learning" was the design and implementation of an authorial e-learning course "Histology, Cytology, Embryology" on the Moodle platform. During the work, the following results were achieved:

1) e-learning course development and administration on the Moodle platform: mastering the learning management system tools to design the course's logical structure, arrange instructional modules, provide methodological support, and configure interactive elements;

2) design of the control and evaluation system: developing a comprehensive bank of diverse test items (multiple-choice, matching, open-ended questions, etc.) and setting up a flexible automated system for assessing student academic performance;

3) practical component: developing a mapping matrix between topics and practical tasks within the study program for the discipline "Histology, Cytology, Embryology", recording and uploading instructional videos to a YouTube channel, systematizing a UI Kit to maintain a unified visual style, and creating comparative presentations alongside anti-presentations.



Fig. 1. Logo of the e-learning course "Histology, Cytology, Embryology".

To visualize and structure complex scientific concepts, scribing was employed, and static video content was transformed into interactive videos. Additionally, educational crosswords were developed on the LearningApps platform, cinquains were designed on the Padlet interactive online board, and other digital activities essential to the effective organization of blended learning were mastered.

Below are some outcomes of practical activities conducted during the course. An authorial logo was created for course visualization and branding (*Fig. 1*).

The visual capabilities of light microscopy are presented in the form of an algorithmic flowchart (*Fig. 2*).

To foster critical thinking and cause-and-effect analysis, a Fishbone diagram template (*Fig. 3*) was developed, which is utilized during group work to categorize factors.

On the Bukovinian State Medical University e-learning platform (*e-osvita*), the author serves as a

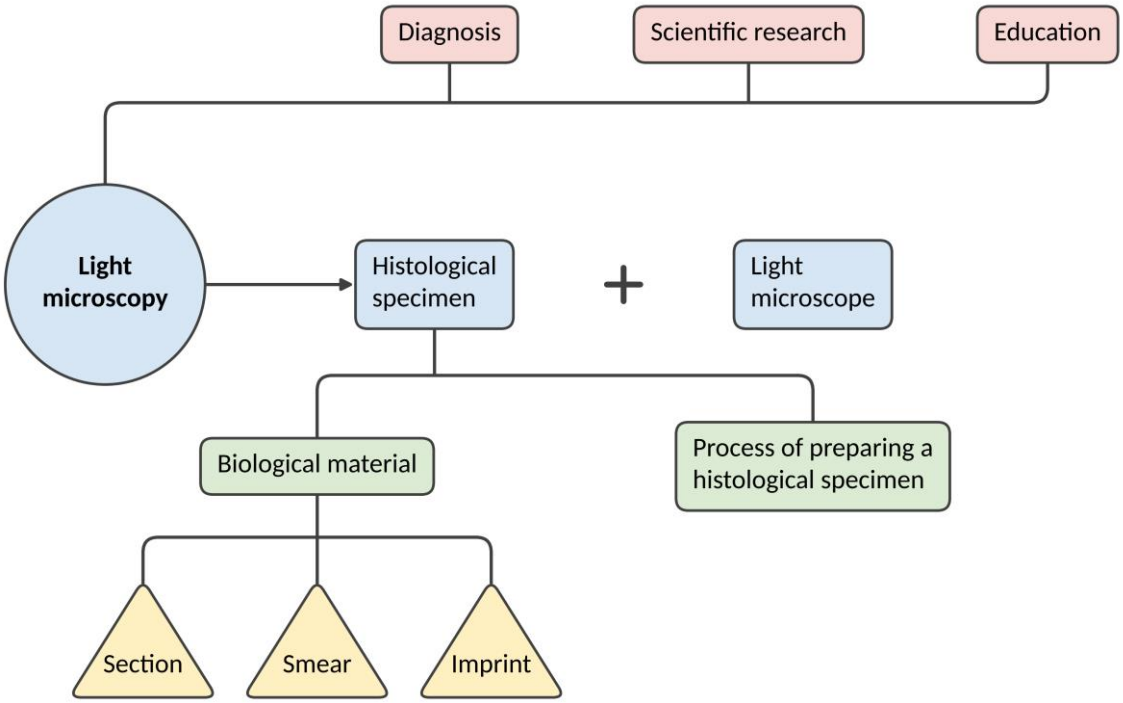


Fig. 2. Algorithmic flowchart of light microscopy.

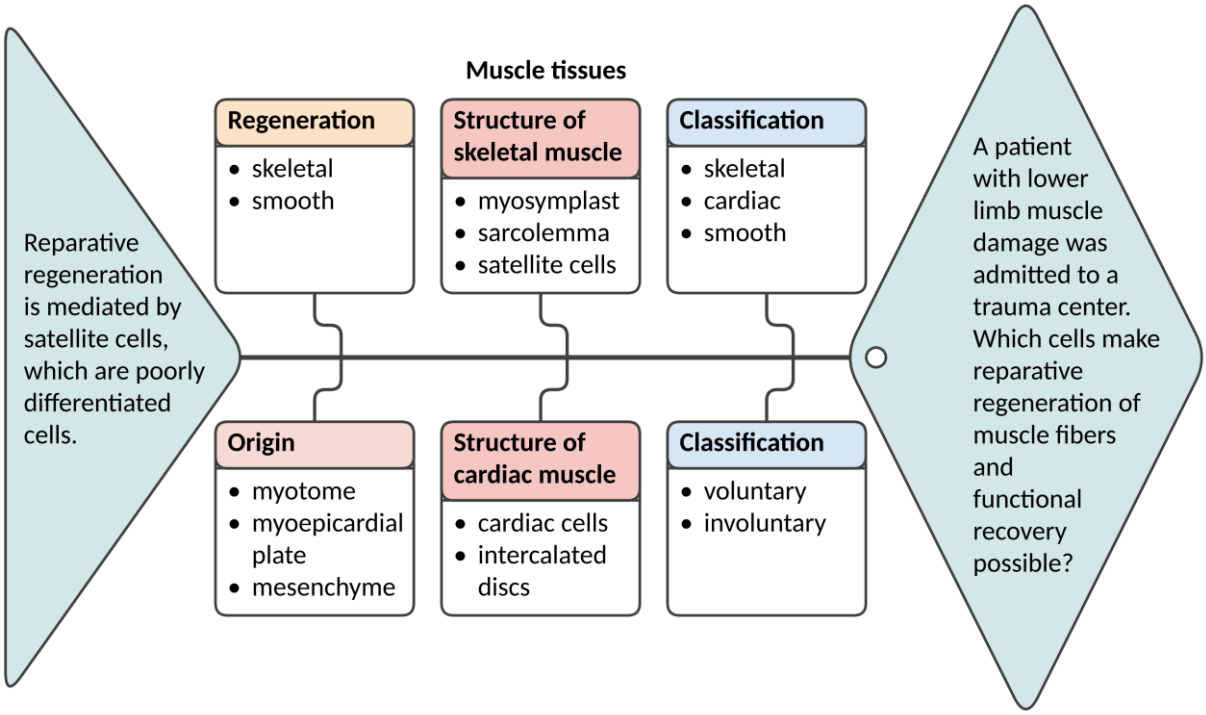


Fig. 3. Fishbone diagram for the topic "Muscle tissues".

manager and instructor for the following e-learning courses:

1) the course "Module 1. Cytology and Medical Embryology. General Histology" for 1st-year students majoring in "Medicine" [10];

2) the course "Module 2. Special histology and embryology" for 2nd-year students majoring in "Medicine" [11];

3) the elective course "Clinical Histology with English Terminology for Dental Practitioners" for 3rd-year students of the Faculty of Dentistry majoring in "Dentistry" [12].

The main scientific and practical result of the study was the development and implementation of author-developed e-learning courses in "Histology, Cytology, Embryology" on the e-learning platform of Bukovinian State Medical University.

This enabled the systematization and standardization of the digital content of e-learning courses through the application of a unified UI Kit, an author-developed logo, and the logical structuring of complex morphological material. The integration of video content, educational crosswords, and online whiteboards optimized face-to-face practical classes by freeing up time for practical light microscopy and solving clinical situational tasks. The established test bank and interactive learning formats ensured continuous monitoring of knowledge comprehension, fostered critical thinking, and facilitated active communication between the instructor and students.

Thus, improving the instructor's digital qualifications directly modernized teaching practice and created conditions to improve the quality of mastering the morphological discipline under blended learning conditions.

Discussion

The transition of medical universities to blended learning necessitates the modernization of teaching methods [1; 2] in morphological disciplines, which traditionally rely on classroom-based instruction. This format requires the continuous development of academic staff's digital competence [3; 5], which serves as an essential prerequisite for the digital transformation of medical education and the integration of innovative technologies into medical training [4; 5].

Using the visual capabilities of light microscopy and graphically structured tasks within the Moodle course complements the findings of Lysachenko O.D. et al. (2023) [7] on the positive impact of visualization on the assimilation of educational material and the acquisition of skills in the differential diagnosis of histological specimens by medical students. However, unlike the approach of these authors, our method, utilizing a unified UI Kit, an author-developed logo, and structured

modules, allowed for not only visualization but also the systematization of digital content into a coherent system.

The integration of modern information and communication technologies, such as H5P-based interactive videos and digital flowcharts, addresses a major challenge of distance education: maintaining student engagement during asynchronous learning by transforming passive content viewing into active learning with self-assessment [13]. The use of gamification elements through Wordwall, LearningApps, and Padlet whiteboards increases the motivation of first-year students, transforming abstract histological concepts into clear visual-spatial structures. At the same time, the full-scale implementation of such interactive tools requires the systematic improvement of the instructors' digital skills and their phased integration into author-developed e-learning courses.

In the context of "Histology, Cytology, Embryology", digital tools do not replace but rather optimize the educational environment [6]. Shifting the preliminary study of tissues and organs, and the use of digital atlases, to an online format allows for more rational use of classroom time. Consequently, during face-to-face classes, students can focus on mastering practical skills, specifically light microscopy and differential diagnosis of histological specimens. Our results highlight the value of combining digital training with traditional light microscopy to increase student engagement.

At the same time, structured approaches such as Benjamin Bloom's taxonomy [14] drew our attention during faculty training as a means to ensure the pedagogical soundness of digital content. Although we did not adopt this framework directly, the established test bank underscores the methodological integrity of the course. The integration of innovative tools, such as AI [9], 3D reconstructions [8], and virtual microscopy platforms [15], forms the basis of this high-tech transformation [4; 9]. Although Maity S. et al. (2023) reported that students prefer virtual microscopy to light microscopy [15], the ultimate metric of the success of this modernization will be its impact on learning outcomes, specifically performance on final module controls and the KROK 1 licensing examination.

Conclusions

The implementation of blended learning in medical higher education institutions requires modernization of teaching methods for fundamental morphological disciplines. Continuous professional development of academic staff in digital pedagogy is a key tool for integrating online theoretical preparation with students' hands-on work during face-to-face practical sessions. The professional development course facilitated the achievement of program learning outcomes, particularly in digital content design and organization of interactive assessment in the Moodle learning management system.

The practical integration of these competencies into the teaching of the "Histology, Cytology, Embryology" educational component will enable the creation of an effective blended learning model. Preliminary analysis of histological specimens and online digital atlases will optimize classroom time, allowing students to focus on developing practical light-microscopy skills at the department.

Prospects for Further Research

Future research will focus on continuous monitoring and analysis of the impact of innovative digital technologies on students' performance in the KROK 1 licensing examination.

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Declarations

Conflict of interest is absent.

The author has agreed to the publication of the article under the terms of the Creative Commons BY-NC-SA 4.0 license and the public agreement with Kharkiv National Medical University, the founder and publisher of the journal, and to the processing and publication of her personal data.

The author of the manuscript declares that in the process of conducting research, preparing, and editing this manuscript, she did not use any generative artificial intelligence tools or services to perform any of the tasks listed in the Generative Artificial Intelligence Delegation Taxonomy (GAIDeT, 2025). All stages of the work (from the development of the research concept to the final editing) were performed exclusively by the author, without the involvement of generative artificial intelligence.

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