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Yashkina Tetiana Olegivna Ph.D. (Medicine), Assistant Professor of the Department of Family Medicine at the Faculty of Postgraduate Education and Propaedeutics of Internal Medicine, Dnipro State Medical University, Dnipro, tel.: (066) 817-18-79, https://orcid.org/0000-0002-1747-4849.

DOUBLE HELIX CURRICULUM AS AN INNOVATIVE MODEL OF MEDICAL EDUCATION: THEORETICAL REFLECTIONS AND PRACTICAL ANALYSIS OF THE ADVANTAGES OF AN INTEGRATED APPROACH

Abstract. The article explores the *Double Helix Curriculum* (DHC) as an innovative model of medical education designed to ensure the equal and continuous integration of biomedical and humanitarian components throughout all stages of physician training. It substantiates the relevance of implementing DHC in the context of contemporary healthcare challenges, which require physicians to possess not only advanced scientific knowledge but also developed clinical reasoning, interdisciplinary collaboration skills, ethical reflection, and communication abilities within complex sociocultural environments. Drawing on international experience from institutions such as the University of Michigan, UCSF, and the University of Toronto, the author outlines the model's two intertwined "strands": the scientific strand (covering basic and clinical sciences) and the humanitarian strand (encompassing medical ethics, communication, social determinants of health, self-reflection, and narrative medicine). The article emphasizes that, within DHC, professional identity is cultivated systematically rather than incidentally, through students' engagement in communities of practice, narrative modeling of clinical cases, facilitated reflection, and integrated learning scenarios. A comparative analysis with other educational approaches (Spiral Curriculum, Case-Based Learning, Vertically Integrated Curriculum, Problem-Based Learning, Competency-Based Medical Education) demonstrates DHC's unique capacity to merge cognitive and value-based competencies. The paper also examines opportunities for adopting DHC in Ukrainian medical education, identifying potential barriers such as curriculum inertia, insufficient faculty preparation for interdisciplinary teaching, and lack of validated tools to assess humanitarian competencies, as well as suggesting strategies to address them. The author concludes that DHC promotes the harmonization of Ukrainian medical education with European standards and fosters the development of a holistic new-generation physician who combines scientific rigor with professional empathy and humanistic values.

Keywords: medical education, Double Helix Curriculum, professional identity, integrated learning, reflection, narrative medicine.

Журнал «Перспективи та інновації науки»
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Яшкіна Тетяна Олегівна доктор філософії з медицини, асистент кафедри сімейної медицини ФПО та пропедевтики внутрішньої медицини Дніпровського державного медичного університету, м. Дніпро, тел.: (066) 817-18-79, https://orcid.org/0000-0002-1747-4849.

DOUBLE HELIX CURRICULUM ЯК ІННОВАЦІЙНА МОДЕЛЬ МЕДИЧНОЇ ОСВІТИ: ТЕОРЕТИЧНІ РОЗМІРКОВУВАННЯ ТА ПРАКТИЧНИЙ АНАЛІЗ ПЕРЕВАГ ІНТЕГРОВАНОГО ПІДХОДУ

Анотація. Стаття присвячена дослідженню концепції *Double Helix Curriculum* (DHC) як інноваційної моделі медичної освіти, що передбачає рівнозначну та безперервну інтеграцію біомедичних і гуманітарних компонентів у підготовку майбутніх лікарів. У роботі обґрунтовано актуальність впровадження DHC в умовах сучасних викликів охорони здоров'я, коли від лікаря вимагається не лише високий рівень наукової компетентності, а й сформоване клінічне мислення, здатність до міждисциплінарної співпраці, етичної рефлексії та комунікації в складних соціокультурних умовах. Автор аналізує міжнародний досвід реалізації DHC (University of Michigan, UCSF, University of Toronto) та показує, що ключовими складовими моделі є дві взаємопов'язані «спіралі»: наукова (фундаментальні та клінічні дисципліни) та гуманітарна (медична етика, комунікація, соціальні детермінанти здоров'я, саморефлексія, наративна медицина). Підкреслено, що професійна ідентичність лікаря в DHC формується системно, а не випадково, через залучення студентів до спільнот практики, наративне моделювання клінічних ситуацій, фасилітовану рефлексію та інтегровані освітні сценарії. Проведено порівняльний аналіз DHC з іншими навчальними підходами (Spiral Curriculum, Case-Based Learning, Vertically Integrated Curriculum, Problem-Based Learning, Competency-Based Medical Education), виявлено його унікальну здатність поєднувати розвиток когнітивних та ціннісних компетентностей. Розглянуто можливості впровадження моделі в українській медичній освіті, окреслено бар'єри (інерційність програм, кадрова підготовка, відсутність інструментів оцінювання гуманітарної складової) та шляхи їх подолання. Автор робить висновок, що DHC сприяє гармонізації української медичної освіти з європейськими стандартами та формує цілісного лікаря нового покоління, який поєднує науковий підхід, професійну емпатію та гуманістичні цінності.

Ключові слова: медична освіта, Double Helix Curriculum, професійна ідентичність, інтегроване навчання, рефлексія, гуманітарна медицина.

Problem statement and its relation to important scientific or practical tasks.

In the 21st century, medical education faces a dual challenge: on the one hand, ensuring high academic training of students, and on the other, developing clinical thinking, professional identity, interdisciplinary communication, and decision-making

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 8(54) 2025

skills under uncertainty. The traditional separated model of teaching fundamental and clinical disciplines no longer meets the needs of modern medicine. The gap between theoretical knowledge and clinical practice creates a disconnect between what students are taught and what they must be able to do in the real healthcare system.

In response to these challenges, leading medical universities around the world are developing integrative educational models, among which particular attention is given to the Double Helix Curriculum (DHC) – a concept that envisions the simultaneous and equally significant integration of biomedical and sociocultural components of education throughout the entire course of medical training. The goal of this model is to shape a "physician with integrated clinical, humanitarian, and professional competence" – one who possesses both scientific thinking and sensitivity to the patient's context and social environment.

Given the need to modernize medical education in Ukraine, particularly in the context of transitioning to a competency-based model, the implementation of the Double Helix Curriculum may become a strategic step towards European harmonization. At the same time, it is necessary to consider the model's adaptability to local educational and cultural contexts, resource availability, and the professional culture of faculty members.

Analysis of recent studies and publications addressing the problem and forming the basis for this work; identification of previously unresolved aspects of the general issue

The concept of the Double Helix Curriculum (DHC) was first systematically presented in the early 2010s as a response to critical observations regarding the fragmentation of traditional medical education. Over the past decade, the model has been further developed in leading institutions such as the University of Michigan, UCSF, and the University of Toronto, where DHC is regarded not only as an educational innovation but also as a strategy for humanizing the medical profession.

A distinctive feature of the Double Helix Curriculum is its integration of two educational "strands":

- The **scientific strand**, focused on fundamental and clinical sciences;
- The **humanitarian strand**, encompassing ethics, communication, social determinants of health, self-reflection, and interprofessional collaboration.

These two strands (Fig. 1) intertwine at every stage of training, creating the conditions for continuous development of not only knowledge but also professional identity. Evidence from long-term qualitative studies shows that such parallel integration enables students to maintain motivation, preserve humanistic values, and at the same time build a solid scientific foundation.

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 8(54) 2025

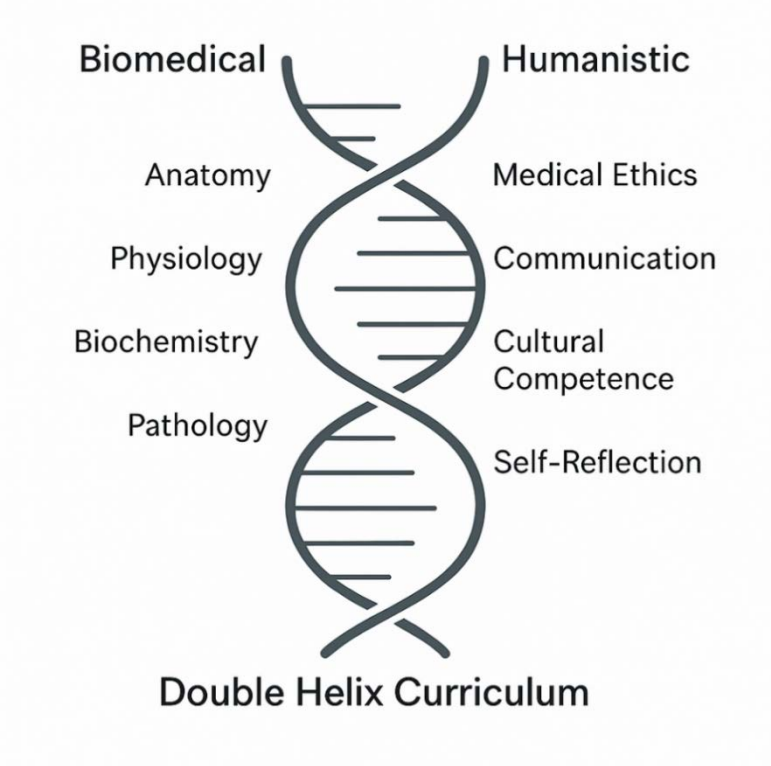

Fig. 1. Conceptual model of the Double Helix Curriculum

One of the key goals of modern medical education is not only the transmission of knowledge and skills but also the formation of the physician's professional identity — the awareness of oneself as a responsible, autonomous, ethical, and socially oriented professional. Within the framework of the *Double Helix Curriculum* (DHC), identity formation is regarded not as a byproduct of education but as the central axis connecting the biomedical and humanitarian components of the learning process.

In the DHC structure, professional identity is not passively acquired — it is actively constructed through the student's engagement in an educational environment where knowledge, values, and experience are interwoven into a single educational spiral. One of the leading mechanisms of such development is **narrative modeling**: students work with clinical stories that focus not only on diagnosis but also on the patient's lived experience, values, emotions, and social context. This narrative immersion fosters empathy, moral imagination, and a deeper understanding of the essence of "person-centered" medicine. In DHC, interaction with the patient is always more than taking a medical history; it is participation in another person's life journey, which forms the basis for the moral self-determination of the future physician.

Another critical mechanism is **engagement in communities of practice** — clinical groups, microlearning environments, and multidisciplinary teams. In these contexts, students observe role models (faculty members, mentors), internalize professional norms, and understand social expectations. Through participation in such communities, students gradually internalize the image of the physician not merely as a technical executor but as a bearer of social authority and moral responsibility.

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 8(54) 2025

At the core of DHC lies **reflection**, which performs an integrative function. Reflection serves as a means of making sense of experiences, identifying personal change, and building connections between theoretical knowledge and practical actions. Facilitated reflection — implemented through written essays, portfolios, and group discussions — enables students to critically reassess their own behavior, mistakes, and areas for growth. This process not only reduces the risk of professional burnout but also enhances self-awareness, which is a prerequisite for sustainable professional development.

Thus, DHC ensures a **multidimensional process** of professional identity formation: from the cognitive acquisition of norms to the personal integration of the physician's role. Reflection serves not only as a pedagogical tool but also as a psycho-emotional resource that supports the student in the challenging process of professional transformation. In the context of modern challenges in medicine — increasing complexity of clinical cases, ethical dilemmas, and systemic pressures — the ability to engage in reflective thinking and align oneself with humanistic values becomes the key to developing a holistic new-generation physician.

In comparison with other educational approaches, DHC not only integrates content but also **integrates identity**. This is critically important in light of current demands for physicians to be reflective practitioners capable of adaptation, empathy, and systems thinking.

Despite its advantages, several aspects of this model require further study:

- development of tools for assessing the effectiveness of DHC, particularly in measuring the impact of humanitarian integration on clinical competence and professional behavior;
- faculty training for interdisciplinary teaching;
- adaptation to resource-limited contexts, such as countries with transitional economies, including Ukraine;
- balancing the model's flexibility with the need for standardized assessment.

Thus, although the foundations of the Double Helix Curriculum have been described and tested in certain educational contexts, there remains a need for theoretical and methodological exploration of its implementation in different countries, especially those with distinct educational cultures.

The purpose of this scholarly and methodological article is to provide a theoretical justification and critical analysis of the Double Helix Curriculum as an innovative educational model for training physicians capable of effectively functioning in the face of contemporary healthcare challenges. The study focuses on DHC's potential to integrate biomedical and humanitarian components in the development of clinical reasoning, professional identity, and interdisciplinary competence in future physicians.

Presentation of the main material with full justification of the obtained scientific results.

The Double Helix Curriculum is based on the concept of parallel development of the professional and personal dimensions of the physician. Its architecture is visualized

as a double spiral: the first (biomedical) spiral encompasses anatomy, physiology, biochemistry, pathology, pharmacology, and clinical diagnostics; the second (humanitarian) spiral includes medical ethics, communication, cultural competence, self-reflection, narrative medicine, and systems thinking.

The key principle is that neither component is subordinate to the other. Students learn simultaneously to "think like a biomedical scientist" and to "demonstrate emotional sensitivity and professional empathy," which fosters a deeper understanding of both the patient and the physician's role within the healthcare system. For example, a cardiology course may include not only heart physiology, ECG interpretation, and pharmacotherapy but also the study of patient narratives about living with heart failure, analysis of ethical dilemmas in palliative care, communication with relatives, and examination of the social determinants of disease.

Table 1.

Comparative analysis with other educational models

Criterion	Spiral Curriculum	Case-Based Learning	Vertically Integrated Curriculum	Double Helix Curriculum
Knowledge structure	Gradual complication	Situational learning	Early clinical exposure	Parallel integration
Professional identity	Informally formed	Partially present	Weakly reinforced	Systematically cultivated
Social context	Episodic	Mostly ignored	Topic-dependent	Mandatory component of training
Role of teacher	Content expert	Case facilitator	Clinical mentor	Mentor and facilitator of culture

Compared to these integrative models, the Double Helix Curriculum (DHC):

1. provides a deeper intertwining of the cognitive and value-based components of learning;

2. supports the formation of a physician as a thoughtful, empathetic, and responsible professional;

3. offers new approaches to interdisciplinary collaboration in the educational process.

In addition to the models discussed, it is worth including an analysis of the Problem-Based Learning (PBL) and Competency-Based Medical Education (CBME) approaches, which are widely used worldwide. Problem-Based Learning is based on small-group learning, where students solve clinical problems under the facilitation of a tutor. This approach stimulates the development of clinical reasoning, self-directed learning, and teamwork. However, PBL often does not address the humanitarian aspects

of the profession, such as reflection, a culture of care, or ethical sensitivity. DHC broadens these boundaries through the integration of narrative medicine, ethics, and professional identity. Competency-Based Medical Education focuses on achieving clearly defined learning outcomes — competencies. This promotes standardized assessment but can reduce the complex identity of a physician to a set of functions. In contrast, DHC offers a holistic framework that combines competency development with the cultivation of thinking, values, and personal maturity.

Thus, DHC does not replace previous models but synthesizes their strengths, adding an emphasis on the development of a reflective, adaptive physician personality.

The analysis of the educational situation in Ukraine (in particular, based on observations from pilot postgraduate training programs) makes it possible to highlight the following directions for implementing DHC:

1. **Creating a modular structure with dual integration.** Modules should include both biomedical and humanitarian components. Example: *"Diabetes as a biomedical and social phenomenon"*, incorporating clinical aspects, social determinants, and communication with elderly patients.
2. **Developing integrated educational scenarios and simulations.** Scenarios should include emotional and ethical aspects of clinical situations. Small-group learning should be accompanied by mandatory reflection.
3. **Training interdisciplinary teaching teams.**

Joint teaching by clinicians and specialists in medical ethics, psychology, and social medicine.

4. **Embedded reflection and narrative practice.**

Regular reflection sessions for students (reflective writing, portfolios, supervised discussions of clinical cases).

5. **Double-helix assessment.**

Formative assessment of the humanitarian strand: feedback, reflection, self-assessment. Combination with the competency-based assessment model (EPA, GRS).

Special attention should be given to the barriers to implementing DHC in Ukrainian medical education. Firstly, there is the inertia of existing curricula, which are structured along disciplinary lines and separate fundamental and clinical knowledge. Secondly, insufficient faculty preparation for interdisciplinary and facilitative teaching styles. Thirdly, the lack of validated tools for assessing the humanitarian component, including empathy, professional identity, and ethical reflection.

Another barrier is the organizational structure of most medical universities, which lack stable mechanisms for coordination between departments of basic sciences, clinical departments, and humanities. Financial constraints and the absence of simulation centers and narrative platforms complicate the full implementation of the DHC model. Overcoming these barriers is possible through the development of pilot integrated modules, institutional support for teaching teams, the introduction of multi-component assessment, and the cultivation of a learning culture focused on professional growth.

Журнал «Перспективи та інновації науки»
(Серія «Педагогіка», Серія «Психологія», Серія «Медицина»)
№ 8(54) 2025

Conclusions and prospects for further research.

The introduction of the Double Helix Curriculum (DHC) model into medical education responds to contemporary global challenges that require physicians not only to possess deep scientific knowledge but also to demonstrate a high level of humanistic awareness, the ability to reflect, communicate, and act in complex sociocultural contexts. An analysis of international experience indicates that this model fosters the holistic development of professional identity and enhances student motivation through an increased awareness of the relevance of learned material to clinical practice.

For Ukraine's educational system, the Double Helix Curriculum is promising in the context of adapting to European standards and advancing the competency-based approach. At the same time, its implementation requires comprehensive transformation at several levels. First, it is necessary to rethink educational design, transitioning to a modular structure that ensures dual — horizontal and vertical — integration of content. Second, the role of the teacher must change: instead of serving solely as a transmitter of knowledge, the modern educational process requires the teacher to act as a mentor and facilitator, capable of creating conditions for the development of critical thinking, reflection, and value-based decision-making. Third, it is essential to revise the assessment system, particularly through the development of valid, reliable, and representative tools for measuring humanitarian, ethical, and interpersonal competencies, which remain insufficiently evaluated in Ukrainian medical education.

Prospects for further research include:

1. Empirical study of the impact of DHC on the clinical effectiveness of graduates in real-world practice.
2. Development of national guidelines for implementing DHC, considering local resources.
3. Comparative analysis of models of professional identity among students trained under DHC and other approaches.
4. Creation of assessment systems for the "humanitarian strand."
5. Exploration of faculty experiences in interdisciplinary teaching — identifying barriers and enabling factors.

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