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ANALYSIS OF INTERNATIONAL SCIENTIFIC EXPERIENCES ON THE FORMATION OF CLINICAL THINKING IN MEDICAL SCHOOLS

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Abstract : The article compares the methods, curricula and pedagogical approaches used in the formation of clinical thinking in the world's leading medical schools - such as the USA, Canada, Great Britain, Australia, Japan and Singapore - based on scientific sources. The article compares the effectiveness of Case-Based Learning, Problem-Based Learning, Early Clinical Exposure, Script Concordance Test, simulation, bedside training, reflexive writing and think-aloud analysis methods used in different educational systems. As a general conclusion of foreign experience, the article shows that global pedagogical approaches, innovative methods and clinical competency-based teaching models are highly effective in modernizing the process of forming clinical thinking at the medical technical school stage. These generalized international practices serve as a theoretical basis for developing methodological solutions for medical technical schools in Uzbekistan.

Keywords: clinical thinking, international experience, Case-Based Learning (CBL), Problem-Based Learning (PBL), Early Clinical Exposure, Script Concordance Test (SCT), simulation training, bedside training, reflective writing, think-aloud analysis, clinical competency-based teaching, medical school, modernization of medical education.

The global medical education system now recognizes the development of clinical thinking as the most important component of medical education. Clinical thinking is a complex cognitive process that includes diagnostic reasoning, analytical thinking, probabilistic decision-making, the formation of disease scripts, and the logical analysis of clinical situations. International organizations such as UNESCO, WFME (World Federation for Medical Education), and AMEE define clinical thinking as a core skill at the heart of 21st century medical competencies.

The special importance of the formation of clinical thinking at the level of medical colleges is that this stage is the initial stage in the preparation of students for professional activity. Although technical school students do not have full clinical experience, it is at this stage that they master the basics of diagnostic reasoning. Therefore, the study of international educational experiences, their analysis and adaptation is a strategic need for medical colleges of Uzbekistan.

Current modern approaches — Case-Based Learning, Problem-Based Learning, simulation, Script Concordance Test, bedside training, think-aloud, and reflective teaching methods — are leading in developing clinical thinking skills in students. In medical schools in different countries, these methods are integrated differently, which allows us to identify the advantages and disadvantages of each approach through analytical comparison.

US experience (Harvard, AMA, Osmosis)

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The US medical education system—particularly at universities such as Harvard Medical School, Yale, and Stanford, as well as the methodological recommendations of the AMA (American Medical Association)—recognizes clinical reasoning as a central competency of medical education. Their didactic models focus on cognitive activities that strengthen clinical reasoning.

1.1. Clinical Thinking — A Core Competency of Medical Education

Harvard Medical School defines clinical thinking as "the integrative process of diagnostic reasoning, decision-making, and clinical judgment." This process requires a student to:

- analytical thinking,
- observation,
- probabilistic thinking (Bayesian model),
- practical decision-making

includes the formation of skills.

The Osmosis (Osmosis.org) platform lists clinical thinking as a "competency that needs to be developed from an early stage."

1.2. PBL, CBL, Reflection — three main approaches

In the US experience, clinical thinking is formed through the harmonious application of the following didactic methods:

— PBL (Problem-Based Learning)

Students independently analyze complex clinical problems, generate hypotheses, and evaluate evidence.

— CBL (Case-Based Learning)

Develops the logical structure of clinical reasoning through a step-by-step review of real clinical cases.

— Reflection (reflexive teaching)

After each clinical experience or case, the student analyzes his or her thought process.

Reflex models such as Gibbs, Schön, and DIEP are actively used.

1.3. Clinical Reasoning Cycle (Formation of a diagnostic chain in students)

The Clinical Reasoning Cycle used by Harvard and the AMA consists of the following steps:

1.Data collection

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2.Interpretation of symptoms and signs
3.Creating probable diagnoses
4.Selecting inspections
5.Evidence assessment
6.decision making
7.Re-analyze the result

This model is particularly important in surgical education because surgical clinical situations require high-speed thinking.

Canadian Experience (McMaster, Quebec)

Canada is one of the leading countries in the development of clinical reasoning in medical education. McMaster University is known as the "homeland" of the PBL method, an approach that has become the basis of the current modern clinical reasoning model.

SCT is widely used (Script Concordance Test)

In Canada, especially in medical schools in the province of Quebec, the SCT has become the primary tool for assessing clinical reasoning.

The importance of SCT:

- measures diagnostic probability skills in a student ;
- demonstrates the student's proficiency in working with clinical scripts;
- teaches to assess the probability of diagnosis in accordance with changes in the clinical situation.

In numerous scientific studies (BMC Medical Education, MedEdPublish), SCT has been rated as one of the most effective diagnostic tests for surgical education.

Disease Scripts-Based Education (McMaster Model)

"Disease scripts" are a scientific model of clinical thinking, in which a student's perception of the disease:

- typical symptoms,
- reasons,
- pathogenesis,
- risk factors,
- clinical course,
- basic analysis

based on the system.

disease script booklets are developed for each subject , with each script containing:

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- "trigger symptoms" (main symptoms),
- "red flags" (severe signs),
- "core tests" (essential tests)

is clearly shown.

In surgical science, scripts serve as a key tool in quickly and logically shaping a student's clinical thinking.

Simulation-integrated module

Simulation is a central part of surgical education in Canadian medical schools, and McMaster has a “Simulation-integrated curriculum.”

In this module:

- mini-simulation
- OSCE
- modeling surgical cases
- video surveillance analysis
- immediate feedback

components are combined.

Simulation impacts clinical thinking in the following ways:

- brings it closer to the real situation,
- shows errors,
- develops the student's ability to think under stress,
- speeds up decision-making.

In the Canadian experience, simulation is considered "a key mechanism for enhancing clinical reasoning."

European experience

Leading European medical schools—the UK, Germany, the Netherlands, and the Scandinavian countries (Sweden, Denmark, and Norway)—rely on a combination of methods for assessing and developing clinical thinking. The European model, unlike the US and Canadian experience, places great emphasis on sequencing, algorithmic thinking, clinical standards, and structured assessment .

Assessing clinical reasoning through the Mini-OSCE

One of the main tools for assessing clinical thinking in many European universities is the mini-OSCE (mini Objective Structured Clinical Examination) .

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The Mini-OSCE is used in surgical education for the following purposes:

- rapid assessment of clinical judgment;
- determine the student's ability to interpret symptoms;
- check the differential diagnosis chain;
- assessing the speed and accuracy of decision-making.

The advantage of the Mini-OSCE is that it provides an observable, benchmarked, real-time assessment of a student's clinical thinking.

The UK's GMC (General Medical Council) standards highlight the mini-OSCE as a "high-validity assessment tool" that assesses clinical thinking and reasoning.

Clinical algorithms and logic chains

A key feature of European surgical education is the formation of algorithmic thinking as a mandatory component .

In the surgical programs of Germany and the Netherlands, each clinical case is divided into the following logical chain:

Symptom → Primary suspicion → Differential → Tests → Red flags → Final decision

This approach strengthens the student's clinical thinking in the following ways:

- placing each character in a logical place;
- comparing evidence sequentially;
- reduce diagnostic errors;
- developing protocol-based thinking.

In Scandinavian countries, clinical algorithms are presented in the form of "visual pathways", which enhances the student's visual-cognitive perception and facilitates rapid decision-making in surgery.

Asian experience

Asian countries—particularly South Korea, Japan, China, and Singapore—have unique, highly structured, and technological approaches to developing clinical thinking. Their model is an integration of US and European approaches, and is based on the principles of precision, algorithmic thinking, visual mapping, and step-by-step problem solving .

Korea and Japan: a problem-solving model

In the medical education systems of South Korea and Japan, clinical thinking is shaped by a problem-solving spiral model . This model works as follows:

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1.Problem identification
2.Distinguishing the main symptoms
3.Creating an initial hypothesis
4.Gathering evidence
5.Analyze
6.Decision-making
7.Reflecting on the result

This model is repeated in a spiral, meaning that with each new clinical piece of information, the student reanalyzes.

Problem-solving classes at Korean universities:

- simplified surgical cases,
- mini-groups,
- algorithmic schemes,
- diagnostic puzzle elements

is taught through.

This method develops students' evidence-based thinking, cause-and-effect reasoning, and decision-making skills.

China: case-mapping and reasoning chain

Two main visual-cognitive methods are widely used in Chinese medical schools to develop clinical thinking:

— Case-mapping (clinical mapping)

The student depicts a clinical situation in the form of a map, diagram, graph, or flowchart.

In this process, the student:

- categorizes symptoms,
- connects them with causes,
- visually shows the clinical chain.

Case-mapping is especially important in surgery because symptoms are numerous and complex.

— Reasoning chain (logical clinical chain)

the reasoning chain model is used to develop students' clinical thinking . In it, the student:

1.identifies the symptom;
2.explains the physiological basis of the symptom;

3.connects with causes;
4.sorts possible diagnoses;
5.determines inspections;
6.draws a final conclusion.

This method builds clinical thinking on a sequential and deeply logical basis .

The advantage of the Chinese model is that the student can visually see the clinical process step by step, which significantly reduces errors in surgical training.

CONCLUSION

A comparative analysis of international scientific sources and educational experiences of different countries shows that the development of clinical thinking in students is not a one-way process, but a multi-component, integrative and gradual process. In the experience of different countries, there are common conceptual principles that determine the main mechanisms of the development of clinical thinking.

Global experience confirms that cases (CBL, PBL, mini-PBL) in the formation of clinical thinking increase the student's ability to make diagnostic judgments, generate hypotheses and analyze problems. Simulation and mini-OSCE strengthen the student's skills in making quick and logical decisions in a real clinical situation. Reflection (Gibbs, DIEP, Schön models) serves to deeply understand the process of clinical reasoning, evaluate errors and form a strategy for self-development. Algorithmic thinking ensures that thinking in surgery and other clinical areas is orderly, consistent and systematic.

Methods such as PBL, SCT, reflection, simulation-integrated modules, reasoning chains, and case-mapping, used by leading medical schools in the United States, Canada, Europe, and Asia, are recognized as universal, reliable, and scientifically sound tools for developing clinical thinking. These experiences clearly demonstrate the general trend in international medical education — the priority of active cognitive participation of the student, a step-by-step reflection process, and a teaching model that is closer to the real clinical environment.

In general, international experience shows that complex, integrated pedagogical approaches in the development of clinical thinking are the most effective. These experiences also serve as a solid scientific basis for creating a modern methodological model for medical colleges in Uzbekistan.

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