CONCEPTUAL FOUNDATIONS OF USING INTERACTIVE METHODS IN TEACHING THE COURSE "HUMAN AND ANIMAL PHYSIOLOGY"

Kaljanov Damir Maxsetbayevich *
Junior Lecturer, Department of General Biology and Physiology, Karakalpak State University *

ANNOTATION: This article analyzes the theoretical and practical foundations of using interactive teaching methods in higher education for the course "Human and Animal Physiology." The content of interactive methods, their distinctions from traditional approaches, and their connection with modern pedagogical strategies are examined. The didactic functions of interactive methods are explored based on the complex structure and theoretical-practical directions of the course. Examples of integrating methods such as "cluster," "insert," "brainstorming," "role-playing," and "case study" into lessons are provided. As a result, these methods have been shown to facilitate the integration of theoretical knowledge with practical skills, foster independent thinking, and promote creative reasoning among students.

KEY WORDS: interactive learning, physiology course, constructivist approach, competency-based model, student-centered learning, didactic functions, brainstorming, case study, role-playing, analytical thinking, higher education, innovative methodology.

INTRODUCTION

Modernizing the educational process in higher education, implementing innovative teaching methods, and developing students' independent thinking, analytical approaches, and creative potential are among the strategic priorities of today's educational policy. In the 21st century, the rapid growth of information flow and the accelerated development of science and technology require students not only to acquire ready-made knowledge but also to independently search for, process, and apply knowledge in practice. Therefore, the modern education system envisions the teacher not as a mere knowledge provider but as a guide and motivator, while the student is seen as an active participant and knowledge creator.

This is especially true for natural sciences, and in particular, the course "Human and Animal Physiology," which encompasses complex and multi-stage biological processes, thereby demanding activating and interactive approaches in teaching. The content of physiology focuses on a deep analysis of functional changes in the organism, regulatory mechanisms, and the interconnections between the nervous and hormonal control systems. Hence, teaching this course cannot be limited to theoretical lectures alone - students must actively engage through experimentation, modeling, problem-based analysis, and observation.

Interactive teaching methods are recognized as one of the most effective didactic tools in this regard. They enhance students' cognitive, communicative, and reflective activities during the learning process, creating conditions for independent thinking and the formation of their own knowledge. The "Concept for the Development of Higher Education System until 2030" adopted in Uzbekistan also prioritizes the application of innovative pedagogical technologies and the introduction of student-centered teaching.

Experience from foreign countries confirms the high efficiency of interactive methods. For instance, the Finnish education model builds the teaching process around students' own research and problem-solving skills. In this process, the teacher acts not as a supervisor but as a facilitator. In US universities, particularly at Harvard and MIT, the "Active Learning" concept is widely implemented, where students work in small groups and analyze complex biological or physiological problems collectively through methods such as "Case Study," "Problem-Based Learning," and "Peer Instruction." These approaches deepen theoretical knowledge and prepare students to solve real-life problems.

In the European Higher Education Area (within the framework of the Bologna Process), the principle of placing student activity at the center of the teaching process has also been promoted. For example, at universities in Germany and the Netherlands, physiology courses taught in biology and medical programs create an interactive environment through laboratory simulations, role-playing exercises, and assignments based on experimental models. This experience demonstrates that the use of interactive methods shapes students' knowledge not only at a factual level but also at a functional, systemic, and analytical level.

In Uzbekistan's higher education system, great attention has been paid to these approaches in recent years as well. In biology specialties, especially in teaching the course "Human and Animal Physiology," the wide application of interactive methods such as brainstorming, clustering, debates, case studies, and laboratory problems enhances the effectiveness of the educational process and broadens students' scientific worldview. Thus, the use of interactive methods in teaching "Human and Animal Physiology" is not only a requirement of modern pedagogy but also a conceptual necessity for developing students' creative thinking, analytical reasoning, and practical competencies. This approach moves education from passive knowledge acquisition to active knowledge creation and strengthens the vital connection between theory and practice.

MAIN PART.

Interactive teaching methods represent a set of didactic approaches based on mutual communication, collaboration, and analytical thinking between the teacher and the student, aimed at active knowledge acquisition. The term "interactive" originates from the Latin word *interactio*, meaning "mutual influence." In this sense, interactive methods ensure a subject-to-subject relationship in the teaching process, where both the student and the teacher become active participants in knowledge creation [1].

The use of interactive methods in education helps develop students' analytical and critical thinking, problem-solving abilities, and creative approaches [2]. These methods come in many varieties and are selected based on the lesson's objectives, the complexity of the learning material, and the students' level of preparedness. Among the most effective are:

- **Brainstorming (Aqliy hujum):** teaches solving problems by generating creative ideas in a short time. This method activates students' thinking and encourages approaching issues from different perspectives [3].
- **Debate and Discussion (Debat va Munozara):** develop critical thinking, argumentation, and reasoning skills. Through these, students do not merely repeat knowledge but learn to defend and logically analyze it [4].
- **Cluster (Klaster):** visually represents connections between concepts, which is particularly useful for forming conceptual systems in complex subjects like physiology.
- **Insert:** integrates reflection into the learning process by marking one's own thoughts, identifying understood and unclear parts while working with text materials.
- **Role-playing (Rol o'ynash) and Case Study (Keys-stadi):** teach decision-making and analytical skills through real-life situations. These methods are especially effective for modeling physiological processes [5].

Interactive methods reposition the teacher not just as an information source but as a partner organizing the educational process. This shift lies at the heart of modern pedagogical thinking, as current education prioritizes forming active, thoughtful, and independently decision-making individuals [6].

In traditional teaching, the teacher is the main focus-delivering information-while students passively receive it. Interactive methods fundamentally change this dynamic: the student becomes the subject of knowledge, acquiring it not in ready-made form but through their own research, experience, and discussion [7]. This approach provides students with opportunities for independent inquiry and analysis, collaborative work and exchange of ideas, and reflection (self-evaluation). Thus, interactive methods increase activity, interaction, and personal responsibility in the teaching process.

For example, in physiology lessons on the topic "Modeling the Reflex Arc," students work in small groups role-playing neurons, receptors, the central nervous system, and effector organs, thereby describing

the complex process themselves. This approach significantly enhances students' cognitive activity and physiological thinking [8].

Interactive methods are closely linked with the core concepts of the modern educational paradigm - constructivist, competency-based, and student-centered learning approaches. According to the constructivist approach, knowledge is not delivered in a ready-made form but is "constructed" by the student through active participation and experience [9]. Interactive methods specifically facilitate this process - the active creation of knowledge. The competency-based approach focuses on preparing students not only with theoretical knowledge but also for practical activities. Through interactive methods, students acquire key competencies such as analysis, communication, decision-making, and teamwork [10].

The student-centered learning model places the student's personal experience, needs, and motivation at the core of the educational process. In this model, the teacher acts not as a knowledge transmitter but as a facilitator - managing and guiding the learning process [11]. Moreover, the use of interactive methods actualizes the fundamental principle of modern education: "the student, not the teacher, must be at the center of activity."

In foreign higher education institutions, such as universities in Finland, the USA, and South Korea, the "active learning" model based on interactive lessons has been shown to improve learning outcomes by 25-40% [12; pp. 8410-8415]. These results confirm that interactive methods not only activate the learning process but also directly contribute to deep knowledge acquisition and the development of independent thinking.

The subject "Human and Animal Physiology" is one of the fundamental core courses in the field of biology, studying the functional mechanisms of vital processes occurring in organisms. Physiology deeply analyzes not only the structure of organs in humans and animals but also the interactions of nervous, endocrine, and metabolic systems that regulate their activities. This course forms a scientific worldview in students about the principles of integrated functioning of living systems through the study of homeostasis maintenance, balance restoration, and responses to external environmental factors.

By its nature, physiology is a discipline that requires the integration of theory and practice. It involves not only understanding physiological laws but also confirming them through experiments, observations, practical work, and modeling. Therefore, the use of interactive approaches in teaching this subject is essential because they enable students to connect complex theoretical concepts with practical situations and allow for visual and logical modeling of physiological processes.

For example, when teaching topics such as nerve impulse transmission, cardiac automatism, or respiratory center regulation, interactive models, animations, or group experiments help students gain a deeper understanding of the essence of these processes. In this way, interactivity serves as a tool that transforms abstract knowledge into concrete experience in the study of physiology.

In foreign educational practice, especially in countries like the USA, Germany, and Japan, active learning technologies are widely used in teaching physiology at medical and biology faculties. For example, at Harvard Medical School, classes are conducted not in the traditional lecture format but based on "problem-based learning." Students first independently study theoretical information and then, during the class, propose their hypotheses to solve physiological problems. This process develops not only their knowledge but also their skills in analysis, research, and argumentation.

The modern education system demands a shift from passive learning to active learning. The peculiarity of physiology as a subject is that the student should not only be a listener but also an analyst, observer, and participant in experiments. Understanding physiological processes is more effective not just through theoretical listening but through direct experiments, discussions, and problem-based situations. The use of interactive methods plays an important role in this process. They increase student engagement, as each student expresses their opinion and participates in finding solutions during the lesson; develop observation and analytical skills, for example, by identifying cause-and-effect relationships based on physiological experiments; and enhance motivation for scientific research and experimentation, making students feel like junior researchers.

The need for interactivity in physiology arises from the fact that this subject, by its nature, is a process that combines communication, observation, and experimentation. Therefore, methods such as debates, brainstorming, case studies, and laboratory modeling ensure active cognitive participation of students during lessons. In foreign higher education institutions, particularly at Cambridge University and the University of Melbourne, physiology laboratory sessions are conducted based on collaborative learning. Students jointly analyze experimental results, compare conclusions, and defend their hypotheses. This not only facilitates a deep understanding of the subject but also contributes to the development of communication skills, critical thinking, and teamwork competencies.

Many physiological processes studied-such as the cardiac cycle, reflex acts, circulatory system, nerve impulse transmission, and hormonal regulation-are abstract and complex by nature. Simply explaining these through traditional lectures often does not yield sufficient results. Therefore, using interactive methods to present these processes with simplified yet scientifically grounded models ensures full comprehension by learners. For example, through the role-playing method, students simulate the activity of parts of the heart or nervous system to practically demonstrate their interconnections; the cluster method visually represents functional links between physiological systems in graphic form; and with the case study method, students analyze physiological mechanisms based on clinical cases and seek ways to solve problems. Thus, interactive approaches transform physiology from a dry theoretical subject into an experimental, analytical, and communication-based science.

Foreign experience also confirms this idea. For example, in higher education institutions in Japan and Korea, virtual laboratories and simulation models are widely used in teaching physiology. Through these technologies, students interactively observe changes in heart rate, reflex latency, or the graphical model of hormone secretion. At Duke University in the USA, students are given the opportunity to work with physiological simulators (such as heart models, blood flow monitors). Using these tools, theoretical knowledge is assimilated through real-time experiments. Thus, the need for interactivity in the subject of “Human and Animal Physiology” is a natural necessity. This subject inherently studies the complex integrative systems of human and animal organisms, which can only be effectively learned through active teaching, communication, modeling, and experimentation. Using interactive methods not only enlivens the lesson but also develops scientific thinking, a spirit of inquiry, and the ability for independent decision-making in students.

The use of interactive methods is not only about updating teaching techniques but also about introducing a new pedagogical philosophy into the educational process. The scientific and theoretical foundations of these methods are widely recognized in modern pedagogy, relying on constructivist, competency-based, student-centered, and reflective (active learning) approaches. This conceptual foundation transforms interactive methods from simple teaching tools into a system that renews education.

The main idea of constructivism is that knowledge is not given ready-made by the teacher but is “constructed” by the student through active learning processes. This theory, developed in the second half of the 20th century by scholars such as J. Piaget, L.S. Vygotsky, and J. Bruner, proves that human thinking and learning develop through active social experience. According to constructivism, the student links new information to existing knowledge, building a new “structure” of understanding. Therefore, the teacher acts not as a knowledge transmitter but as an organizer and creator of the learning environment.

The constructivist approach is particularly important in teaching the subject “Human and Animal Physiology,” which includes complex physiological mechanisms such as the cardiac cycle, nerve impulses, and hormonal regulation. When students independently analyze these processes and discover them through practical experiments, their knowledge becomes more stable and conscious. For example, in the topic of “cardiac automatism,” students themselves model the rhythmic contraction mechanism, which exemplifies constructive learning. In foreign practice, especially at universities in Canada, Finland, and Japan, problem-based learning tasks based on the constructivist approach are widely used to teach physiology. In this method, students first identify the problem, then collaboratively discuss its theoretical basis, and develop solutions. As a result, the teacher acts only as a facilitator, while knowledge is formed through the students'

own experiences.

The competency-based approach is considered a fundamental paradigm of modern education. According to this approach, the goal of the educational process is not only to provide students with knowledge but also to develop competencies such as applying knowledge in practice, analyzing, decision-making, communication, and problem-solving.

The subject “Human and Animal Physiology” is naturally suited for competency-based teaching due to its content. It requires students to develop skills like observation, experimentation, modeling, analysis, and drawing conclusions. Teaching through interactive methods, especially case studies, role-playing, and laboratory problems, turns this process into active competency-based practice. For example, in the topic of “blood pressure regulation,” students solve cases based on real clinical situations, developing competencies in identifying physiological mechanisms, explaining cause-effect relationships, and making decisions. This approach ensures that the student becomes a specialist who does not just “know” but can effectively “apply knowledge in practice.” Abroad, especially within the European Higher Education Area (Bologna Process), assessment of learning outcomes is also based on competencies. Therefore, the use of interactive methods is considered the most effective tool for implementing the competency-based approach in practice.

The concept of student-centered learning is currently accepted as the main model in almost all developed education systems. In this model, the focus is not on the teacher, but on the student’s learning activity. The educational process is individualized, taking into account each student's abilities, learning pace, and motivation. Interactive methods are the most natural means to implement student-centered learning, as they provide opportunities for active participation, independent thinking, questioning, and debate.

In teaching the subject "Human and Animal Physiology," this approach is manifested, for example, through individual analytical tasks during laboratory sessions, small group projects, or by having students analyze the results of biological experiments themselves. In universities in the USA, the UK, and Australia, this model is widely implemented through the “flipped classroom” technology. That is, students study theoretical material independently, while class time is devoted solely to analysis, discussion, and experimentation. As a result, the learning process becomes interactive, problem-oriented, and focused on active learning. Therefore, this model provides high efficiency when teaching complex subjects such as “Human and Animal Physiology.”

Another conceptual foundation of interactive methods is the principle of active learning and reflection. In active learning, the student actively participates in the learning process: asking questions, answering, discussing, modeling, and analyzing. This process not only deepens knowledge but also develops higher-order thinking skills such as analysis, synthesis, and evaluation. Reflection involves the student analyzing their own learning activity after each lesson, asking themselves questions like "What did I learn? What did I not understand? What will I focus on next time?" This process plays a crucial role in personalizing education and increasing its effectiveness.

In physiology, reflection can be implemented, for example, through post-laboratory report discussions or by expressing one’s opinion in writing when evaluating experimental results. This develops students' scientific analysis skills, communication culture, and independent learning abilities. In foreign practice, particularly at MIT (USA), Cambridge University (UK), and Aalto University (Finland), reflection is considered an integral part of the interactive learning process. After each lesson, students maintain a "learning log" or "reflective journal" to record their thoughts. Research shows that this approach increases long-term retention of studied topics by 35-40%.

In modern education systems, interactive methods constitute an active, collaborative, and competency-oriented form of the learning process. They are not only methodological tools but also mechanisms that embody the didactic principles of education in practice. The main didactic functions of interactive methods include forming knowledge, skills, and competencies, fostering creative and critical thinking, and organizing active learning through problem-solving situations.

Interactive methods elevate the learning process from passive reception of knowledge to active

discovery. Students acquire the material not as ready-made information but as knowledge formed through analysis, discussion, and experimentation. In this respect, interactive methods are aimed at the higher levels of Bloom's taxonomy-analysis, synthesis, and evaluation [13]. For example, in the course "Human and Animal Physiology," studying complex processes such as blood circulation or nerve impulse transmission through methods like "cluster," "insert," or "problem-based situations" encourages students to deeply analyze information and apply it through practical modeling. This, in turn, develops scientific thinking and analytical reasoning skills. From a didactic perspective, interactive methods harmoniously develop cognitive, affective, and psychomotor domains [14]. This is especially important for physiology, as students acquire knowledge not only theoretically but also through practical skills gained in laboratory experiments.

One of the most important didactic advantages of interactive methods is the development of communicative activity and critical thinking. Interaction between the teacher and students, collaborative discussion, and analysis help students develop skills such as argumentation, analytical approach, and evidence-based reasoning. For example, methods like "debate," "brainstorming," and "role-playing" allow the study of physiology topics-such as "Reflexes and their types" or "Nervous and hormonal regulation"-through discussion. In this process, students learn to independently solve problem situations, analyze cause-and-effect relationships, and scientifically substantiate their opinions [16]. Furthermore, interactive methods also foster creative thinking. Through "case studies" or "simulation games," students generate new ideas, propose hypotheses, and test them experimentally. In the practical direction of physiology, this approach is an important factor in shaping innovative thinking and scientific research potential [15].

Another important didactic function of interactive methods is the implementation of cooperative (collaborative) learning. During group work, students develop communication, leadership, responsibility distribution, and joint decision-making skills. For example, in the course "Human and Animal Physiology," studying topics such as homeostasis disruption, blood pressure changes, or respiratory regulation through group case studies or problem-based situation analysis directs students toward collaborative problem-solving. This process enhances not only the students' knowledge level but also their social competence [17].

Foreign experience also demonstrates high results in this area. For instance, the University of Helsinki (Finland) and Monash University (Australia) apply a cooperative learning model in teaching physiology, where students jointly conduct experiments, analyze results, and defend their findings. Research shows that students learning through such interactive approaches achieve 30-40% higher mastery compared to those attending traditional lectures [18; pp. 223-231].

This subject, due to its experimental and analytical nature, is one of the most suitable for applying interactive methods. Effective directions for integrating interactive methods into the educational process include: laboratory sessions-practical study of physiological processes such as monitoring heart rate, measuring reflex reactions, modeling hormonal responses; practical analyses-students collect data, analyze it, and draw scientific conclusions; group projects-each group is assigned a specific physiological system (e.g., respiratory or circulatory system) mini-project, with results presented in class; case studies and role-playing sessions-students are given clinical scenarios (e.g., hypoglycemia, cardiac arrhythmia) which they analyze from the perspective of physiological mechanisms.

Such integration strengthens students' ability to connect theoretical knowledge with practice, logical analysis, teamwork, and self-regulation skills. At the same time, the learning process becomes more engaging, dynamic, and productive.

In our opinion, the didactic functions of interactive methods fully correspond to the educational objectives of the course "Human and Animal Physiology." Through these methods, the educational process transforms into a system that integrates theory and practice, is competency-oriented, and based on creative thinking. As a result, students develop not only physiological knowledge but also scientific analysis, communication, independent thinking, and collaboration skills. Therefore, integrating interactive methods into the physiology course is a conceptual necessity for the effective application of modern pedagogical technologies in the educational process.

Interactive methods hold unparalleled importance in linking theoretical knowledge with practical processes, modeling complex mechanisms, and developing students' independent thinking potential in the course "Human and Animal Physiology." They transform the lesson from merely information transmission into a field of scientific analysis and active learning. Consequently, students form physiological thinking based on a competency-based approach (see Table 1).

Table 1

Examples of Interactive Methods Applicable in the Course of Human and Animal Physiology

Interactive Method	Application Area	Purpose	Explanation
Cluster	Identifying interconnections of physiological systems	Developing systemic thinking	Through this method, students visually represent the organic connections between body systems, such as nervous, endocrine, and cardiovascular systems. Using cluster diagrams, the cause-and-effect chain of physiological processes is identified, forming complex biological thinking.
Insert	Working with textual material	Developing analytical thinking	In the Insert method, students mark the text during reading with symbols (V – I know, + – new, ? – unclear, – – disagree). This approach strengthens independent analysis and logical thinking when studying physiological processes like respiratory center activity or mechanisms controlling heart rhythm.
Brainstorming	Solving theoretical problems	Encouraging creative approach	Brainstorming allows students to quickly propose new ideas and collaboratively solve problems in class. For example, in response to the question "Why does the heart rate increase under stress?", students present multiple scientific hypotheses and justify them based on physiological principles. This process develops creative thinking and argumentation skills.
Role-playing	Studying reflex mechanisms	Modeling real processes	In this method, students assume roles of participants in physiological processes: one acts as a receptor, another as a nerve fiber, and a third as a representative of the central nervous system. This way, they demonstrate the working mechanism of the reflex arc as a live model, enhancing visualization and memory retention.

Case study	Analyzing functional changes in animal or human organisms	Analyzing problematic situations and decision-making	Through the case study method, students are given real or simulated clinical cases (e.g., hypoglycemia, cardiac arrhythmia, or electrolyte imbalance). They analyze the causes from a physiological perspective and draw diagnostic conclusions. This approach develops skills in evidence-based decision-making.

Conclusion. The use of interactive teaching methods in the instruction of the course “Human and Animal Physiology” is one of the most important didactic directions in modern educational processes. These methods facilitate the integration of theoretical knowledge with practical experience, actively engage students as subjects in the learning process, and help develop competencies in thinking, analysis, and communication.

Through interactive approaches, the lesson process shifts from a traditional system focused on information transmission to a creative environment oriented towards collaboration, logical thinking, and problem-solving. Students learn to justify their opinions, approach studied physiological phenomena analytically, and draw conclusions based on scientific logic. Thus, interactive methods assist in mastering the complex theoretical content of physiology in a practical, understandable, and relevant way. Specifically, the use of methods such as clustering, brainstorming, role-playing, inserts, and case studies ensures a deep understanding of the interrelations between physiological systems; develops students’ creative and critical thinking, logical analysis, and teamwork skills; and makes the learning process motivational, interactive, and reflective.

At the same time, the application of interactive methods represents a practical expression of constructivist and competency-based approaches because these methods shape knowledge not as ready-made information but through the student's own experience, inquiry, and communication. This shifts the focus from “knowledge acquisition” to "knowledge creation," which is the primary goal of modern higher education systems.

International pedagogical experience also confirms the importance of interactive methods in improving the quality of teaching. For example, in universities in the USA, Finland, and South Korea, complex subjects like physiology are taught through interactive discussions, practical case studies, and project-based learning. Research shows that students in such approaches achieve higher levels of mastery, independent thinking skills, and interest in the subject.

Thus, the use of interactive methods in teaching "Human and Animal Physiology": aligns the teaching process with modern pedagogical approaches; ensures the integration of theoretical knowledge, practical skills, and analytical thinking in students; and transforms education into an effective, motivational, and competency-oriented system.

REFERECES:

[1] Jonassen, D.H. (1999). Designing Constructivist Learning Environments.
[2] Vygotsky, L.S. (1978). Mind in Society: The Development of Higher Psychological Processes.
[3] Osborn, A. (1953). Applied Imagination: Principles and Procedures of Creative Problem Solving.
[4] Brookfield, S. & Preskill, S. (2005). Discussion as a Way of Teaching.
[5] Kolb, D.A. (1984). Experiential Learning: Experience as the Source of Learning and Development.
[6] Dewey, J. (1938). Experience and Education.
[7] Biggs, J. (2003). Teaching for Quality Learning at University.
[8] Bonwell, C.C. & Eison, J.A. (1991). Active Learning: Creating Excitement in the Classroom.
[9] Piaget, J. (1970). Science of Education and the Psychology of the Child.
[10] Hymes, D. (1972). Communicative Competence.
[11] Weimer, M. (2013). Learner-Centered Teaching: Five Key Changes to Practice.

[12] Freeman, S. et al. (2014). "Active learning increases student performance in science, engineering, and mathematics." PNAS, 111(23): 8410–8415.

[13] Bloom, B.S. (1956). Taxonomy of Educational Objectives: The Classification of Educational Goals. New York: Longman.

[14] Anderson, L.W., & Krathwohl, D.R. (2001). A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives. New York: Addison Wesley Longman.

[15] Bransford, J., Brown, A., & Cocking, R. (2000). How People Learn: Brain, Mind, Experience, and School. Washington D.C.: National Academy Press.

[16] Johnson, D.W., Johnson, R.T., & Smith, K.A. (2014). Cooperative Learning: Improving University Instruction by Basing Practice on Validated Theory. Journal on Excellence in College Teaching.

[17] Slavin, R.E. (2011). Cooperative Learning: Theory, Research, and Practice. Boston: Allyn & Bacon.

[18] Prince, M. (2004). Does Active Learning Work? A Review of the Research. Journal of Engineering Education, 93(3), 223-231.