European International Journal of Pedagogics (ISSN: 2751-OOOX)

Received: 04 March 2026 | Accepted: 28 March 2026 | Published: 21 April 2026

DOI: 10.55640/eijp-06-04-27

RESEARCH ARTICLE

Improving the Methodology of Teaching The "Zoology" Course in Higher Education Based on Innovative Pedagogical Technologies (Using the Example Of "Vertebrate Animals")

Khonnazarova M.T.

University of Applied Sciences, Associate professor of the department of preschool education methodology, Uzbekistan

VOLUME: Vol.06 Issue04 2026

PAGE: 142-145

Abstract

This article analyzes the effectiveness of integrating modern pedagogical technologies into the teaching of Zoology, specifically the "Vertebrate Animals" section, within higher education frameworks. In contrast to traditional rote learning, this study highlights the role of 3D modeling, virtual laboratories, and Problem-Based Learning (PBL) in reinforcing student knowledge. Research results demonstrate that an innovative approach not only enhances theoretical comprehension but also develops practical analytical skills and creative thinking.

KEYWORDS

Innovative pedagogy, vertebrate zoology, ict, virtual laboratory, interactive methods, higher education, biological modeling.

INTRODUCTION

The modernization of higher biological education is a priority in the era of digital transformation. "Vertebrate Zoology" is a fundamental pillar of the biology curriculum, providing students with an understanding of evolutionary complexity, morphological adaptation, and ecological roles.

However, traditional methods often face significant challenges:

Static Learning: Reliance on 2D diagrams limits the understanding of 3D anatomical structures.

Ethical Constraints: Growing concerns regarding the dissection of real animals (Bioethics).

Engagement: A gap between classical lecture formats and the digital-native learning style of contemporary students.

To address these issues, it is essential to transition toward a methodology based on Innovative Pedagogical Technologies (IPT).

Theoretical Foundations - The integration of IPT is grounded in several educational psychological theories:

Constructivism and Active Learning

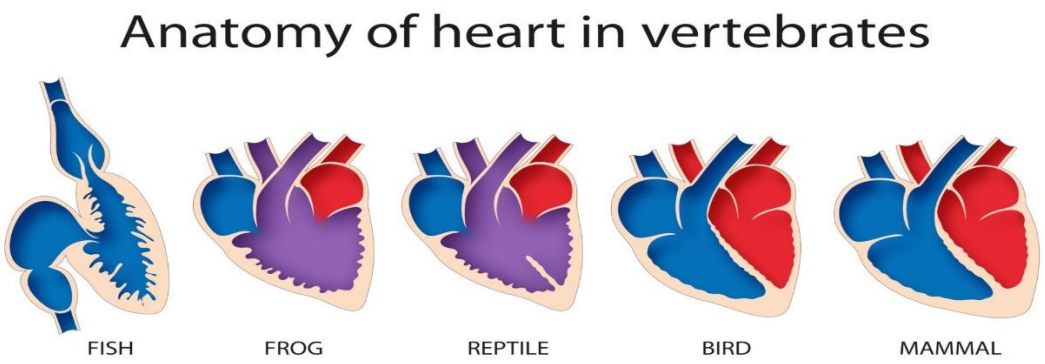
Based on Piaget and Vygotsky's theories, students "construct" knowledge through experience. In Zoology, this means moving from observing a teacher's demonstration to active manipulation of virtual models.

Visual-Spatial Cognition

Vertebrate anatomy is inherently spatial. Technologies like Augmented Reality (AR) allow students to overlay skeletal systems onto muscular systems, fostering a holistic understanding of the organism.

The Concept of "Blended Learning"

Combining traditional field studies (observing vertebrates in nature) with high-tech classroom simulations cr eates a balanced educational environment.



METHODS

The research was conducted through a pedagogical experiment involving Biology undergraduates. The methodology utilized a dual-track approach:

Implementation of ICT Tools

- 3D Digital Atlases: Software such as ZygoteBody or Visible Zoology allowed for the layered study of vertebrate organ systems.
- Virtual Dissection Tables: Using digital platforms to simulate the anatomy of Rana temporaria (frog) or Perca fluviatilis (perch).

Pedagogical Strategies

- Problem-Based Learning (PBL): Students were tasked with solving evolutionary riddles, such as "Analyze the skeletal modifications required for the transition from aquatic to terrestrial life."
- Case Studies: Investigating real-world biodiversity loss in specific vertebrate classes.

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RESULTS AND DISCUSSION

The data collected during the experiment showed a marked improvement in the "Experimental Group" (using IPT) compared to the "Control Group" (using traditional methods).

Comparative Performance Metrics

Morphological Identification	62%	88%	+26%
Evolutionary Logic	55%	81%	+26%
Practical Lab Exam	58%	90%	+32%

Analysis of Findings

The results suggest that Interactivity is the primary driver of success. When students can rotate a 3D model of a bird's respiratory system (with its air sacs), they grasp the concept of "double respiration" significantly faster than through a textbook description.

INNOVATIONS IN VERTEBRATE CLASS STUDIES

Class Agnatha and Chondrichthyes (Primitive & Cartilaginous Fish)

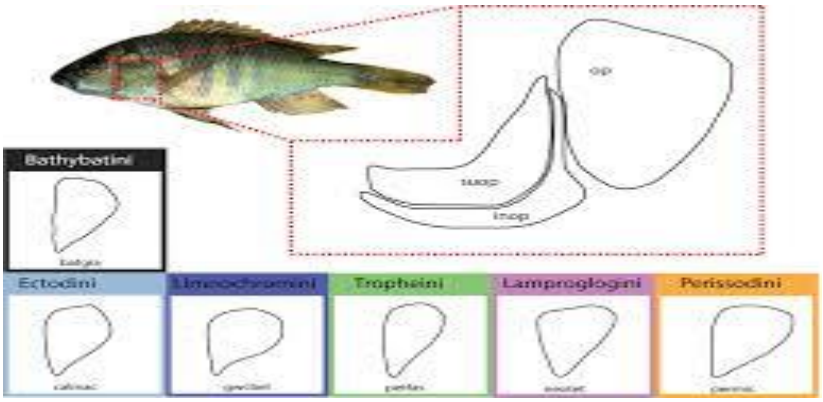
Using hydrodynamic simulations to show how the absence of a swim bladder in sharks affects their constant movement.

Class Amphibia and Reptilia

Virtual "Evolutionary Labs" where students simulate the moisture-dependency of amphibian eggs versus the amniotic eggs of reptiles.

Class Aves (Birds) and Mammalia

Focusing on the nervous system. Using Brain-Mapping software to compare the cerebral cortex development in mammals versus the optic lobes in birds.



The role of the instructor in the innovative environment

Despite the high level of automation, the instructor's role evolves from a "source of information" to a "facilitator".

Guiding Inquiry: Helping students navigate complex data.

Correcting Misconceptions: Ensuring that digital simulations are interpreted through the lens of scientific accuracy.

Ethical Mentorship: Discussing the importance of wildlife conservation alongside digital study.

The discussion should note that while technology improves interest, the teacher's role remains vital in guiding the critical thinking process and correcting misconceptions about evolutionary biology.

CONCLUSION

Improving the methodology of teaching Vertebrate Zoology through innovative technologies is no longer optional but essential. Moving toward Blended Learning—combining the tactile experience of physical specimens with the precision of digital simulations—creates a more robust educational environment. This approach not only improves academic performance but also fosters a deeper professional interest in the biological sciences among university students.

The improvement of teaching "Vertebrate Zoology" through innovative pedagogical technologies yields the following benefits:

- Enhanced Visualization: Complex internal systems become transparent and accessible.
- Efficiency: Accelerated learning curves for difficult evolutionary concepts.
- Ethical Sustainability: Reduction in the need for biological specimens, aligning with global bioethical standards.
- Professional Readiness: Students graduate with both biological knowledge and technical proficiency.

In conclusion, the integration of IPT is not merely a technical upgrade but a fundamental shift in how biological sciences are perceived and mastered in higher education.

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