

THE USAGE OF ARTIFICIAL INTELLIGENCE IN THE STUDY  
OF PRECLINICAL DISCIPLINES OF THE SPECIALTY «VETERINARY MEDICINE»

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**Viacheslav DANCHUK**

Doctor of Agricultural Sciences, Professor  
Institute of Climate-Oriented Agriculture of the NAAS  
e-mail: dan-vv1@ukr.net

**Lyubov SAVCHUK**

Candidate of Agricultural Sciences, Associate Professor  
Higher Education Institution «Podilskyi State University»  
e-mail: lyuba.savchuk.2015@ukr.net

**Volodymyr DOBROVOLSKYI**

Master of Veterinary Medicine  
Higher Education Institution «Podilskyi State University»  
e-mail: dobrovolsky.va@gmail.com

**Introduction.** Artificial intelligence (AI) is no longer science fiction – it has become part of our everyday lives. From smartphones and smart homes to medicine and law, Artificial intelligence is changing the way we work, learn, communicate and even make decisions. The world has embraced AI as a technology that can make our lives easier and drive economic development [1]. The rapid development of Artificial intelligence and cybersecurity often outpaces the legislative process, making many regulatory measures obsolete before they are fully implemented [2].

The use of Artificial intelligence is gradually taking over a wide variety of areas in human life, displacing outdated approaches. In history, only four technologies are known that have changed human life as profoundly as AI: steam power, which gave rise to the industrial revolution; electricity, which changed everything; the discovery of antibiotics and the medical understanding of biochemical transformations and treatment in general; computers and Artificial intelligence software, which created the information age [3].

We set ourselves the task of investigating the main areas of use of Artificial intelligence in animal husbandry and veterinary medicine, and considering the prospects for their inclusion in the educational process in the training of veterinary doctors.

**Presentation of the main material.** The use of Artificial intelligence in human life is not as unconditional as it might seem at first glance. The process is complex and very dynamically developing. For example, the US Food and Drug Administration has allowed the use of Artificial intelligence systems only with «locked» algorithms that do not continue to learn. Evolving systems are suitable for research and development, but commercial systems must be «locked» to give repeatable results [4]. The concept of ecological Artificial intelligence is emerging. «Green city» applications for Artificial intelligence include intelligent automation in energy management, intelligent transportation systems, improved strength and durability of infrastructure, as well as increased individual safety and security through Artificial intelligence surveillance systems and predictive control systems [5].

The use of Artificial intelligence in the educational process poses a number of issues for humanity that require immediate resolution [6]:

– *Anonymity is needed.* Veterinarians are expected to keep their clients' information anonymous and confidential, and it will not be included in the general Artificial intelligence network without the client's consent, but the issue of control arises. On the other hand, where should we draw the line between using private information and using it to improve animal welfare in the region as a whole?

– *Biased results.* If a veterinary specialist does not know the characteristics of the dataset used to produce an Artificial intelligence product, he will not be able to assess its adequacy until a case requires an immediate decision by a veterinarian. The question of possible Artificial intelligence error due to imperfect databases arises, it is difficult to assess the potential harm or benefit of using Artificial intelligence. For example, if an Artificial intelligence training system for ruminants is created without using data related to goats or sheep, the results may be significantly erroneous or inaccurate.

–*Responsibility and supervision.* The use of Artificial intelligence by veterinarians for the analysis of laboratory tests, training, advanced training, diagnosis and veterinary preventive measures should not relieve the practicing veterinarian of responsibility for the consequences of using the AI system in his work. And this is the main and fundamental thing for consumers of veterinary services. Therefore, the educational process of training a veterinarian should include acquiring skills in working with relevant AI systems to obtain specific skills and knowledge.

–*Ethical considerations in the use of Artificial intelligence.* Animal producers may be concerned about what and how often an Artificial intelligence system reports to veterinary clinics, government agencies, competitors, and detractors, and whether this can be done in a secure, confidential, and ethical manner, and whether privacy or copyright are respected. The European Union has developed rules in its General Data Protection Regulation (GDPR), providing some guidance for the European community on the regulation of Artificial intelligence [8]. The veterinary profession may need to revise its ethical principles of veterinary practice to address the many issues surrounding the use of Artificial intelligence systems in animal health care [9].

–*Impact on the workforce.* Of course, a significant impact on the number and qualifications of the workforce is expected when using Artificial intelligence in the production of livestock products and its veterinary support. It is necessary to introduce appropriate courses on the use of Artificial intelligence into the educational process.

–*Accessibility requirements.* Individual states are introducing separate legislation to implement the Digital Charter 2022. “The framework proposed in AIDA is the first step towards a new regulatory system designed to steer Artificial intelligence innovation in a positive direction and encourage the responsible adoption of Artificial intelligence technologies by Canadians and Canadian businesses” [10]:

Artificial intelligence is one of the most remarkable achievements of our time. Its application covers almost all aspects of human life, and it undoubtedly opens up new horizons for scientific progress. However, its impact requires careful ethical, social and legal regulation [11].

Even if Artificial intelligence intelligence processes and models certain manifestations of intelligence, it remains fundamentally bound by a logical-mathematical framework that imposes internal limitations. Human intelligence, by contrast, develops organically over the course of a person’s physical and psychological development, shaped by a multitude of experiences experienced in the body. While advanced Artificial intelligence systems can «learn» through processes such as machine learning, this type of learning is fundamentally different from the development of human intelligence, which is shaped by embodied experience, including sensory input, emotional responses, social interactions, and the unique context of each moment. These elements shape individuals in their personal histories. In contrast, Artificial intelligence, which lacks a physical body, relies on computational thinking and learning from vast datasets that include recorded human experience and knowledge [12].

The effectiveness of human labor and learning depends on many subjective factors, including gender, education level, working hours, and marital status [13]. We can easily add such factors as mood, emotional and physiological state, health of a person and his relatives and friends, creative inclinations, phobias, etc. Artificial intelligence does not have all these human qualities, so it is a high-quality tool for performing complex tasks such as training, managing the production process, or analyzing large amounts of data. Although, one can disagree with our opinion, arguing about the ever-growing impact of this phenomenon on various areas of human life [14]. As Henry Ford said: “Innovation does not mean that people should focus on developing methods to increase the speed of horses. It is about creating faster cars or improving technologies that are faster than horses. These methods have developed industries, including the education sector” [15].

Artificial intelligence is already being used for environmental conservation, focusing on specific situations such as wildlife conservation, monitoring illegal logging, and predicting forest fires, etc. Artificial intelligence technology provides greater accuracy and efficiency than conventional methods, allowing for faster detection and response to forest damage. Artificial intelligence will become more significant in the future with additional technical developments and growing application areas, opening up new avenues for forest conservation and sustainable use [16].

#### *Using Artificial intelligence in the educational process*

The obtained results show that Artificial intelligence can improve the learning process through personalized learning, AI-based interactivity and automated data analysis [17]. It's all about how you approach it. If it is a tool for learning, working, understanding the world and deep analysis, then this is one thing, but if you look at it from another angle, then a new generation of video games and entertainment, improving everyday life, simplifying many decisions, creating new youth subcultures is another.

University education is designed to guide students towards development according to the first model, and therefore Artificial intelligence should be a means for us to study, work, raise children, and have quality

rest. Ensuring the food security of the state depends on veterinary doctors, so the task of universities is to teach how to use all modern technologies that can ensure the health and well-being of the people. Artificial intelligence has been a part of veterinary diagnostics and treatment planning for long a long time. There is a large amount of literature on the use of Artificial intelligence in clinical settings, but there is little AI used for teaching, learning, and assessing such basic disciplines as «Animal Physiology», «Domestic Animal Anatomy», «Cytology, Histology, Embryology».

Trust in the method itself is extremely important for the application of artificial intelligence [18].

Artificial intelligence cannot replace live communication with a teacher who shares his practical experience in learning a particular material that students receive during laboratory classes, especially when working with dummies, wet preparations, animal corpses, studying physiological processes and tissue microstructure, metabolic processes in cells. Artificial intelligence can be a powerful assistant in learning, but it is a person who is able to explain the material taking into account an individual approach and his own experience. Live communication contributes to the formation of critical thinking, discussion and exchange of ideas, which are indispensable for a deep understanding of the above-mentioned disciplines.

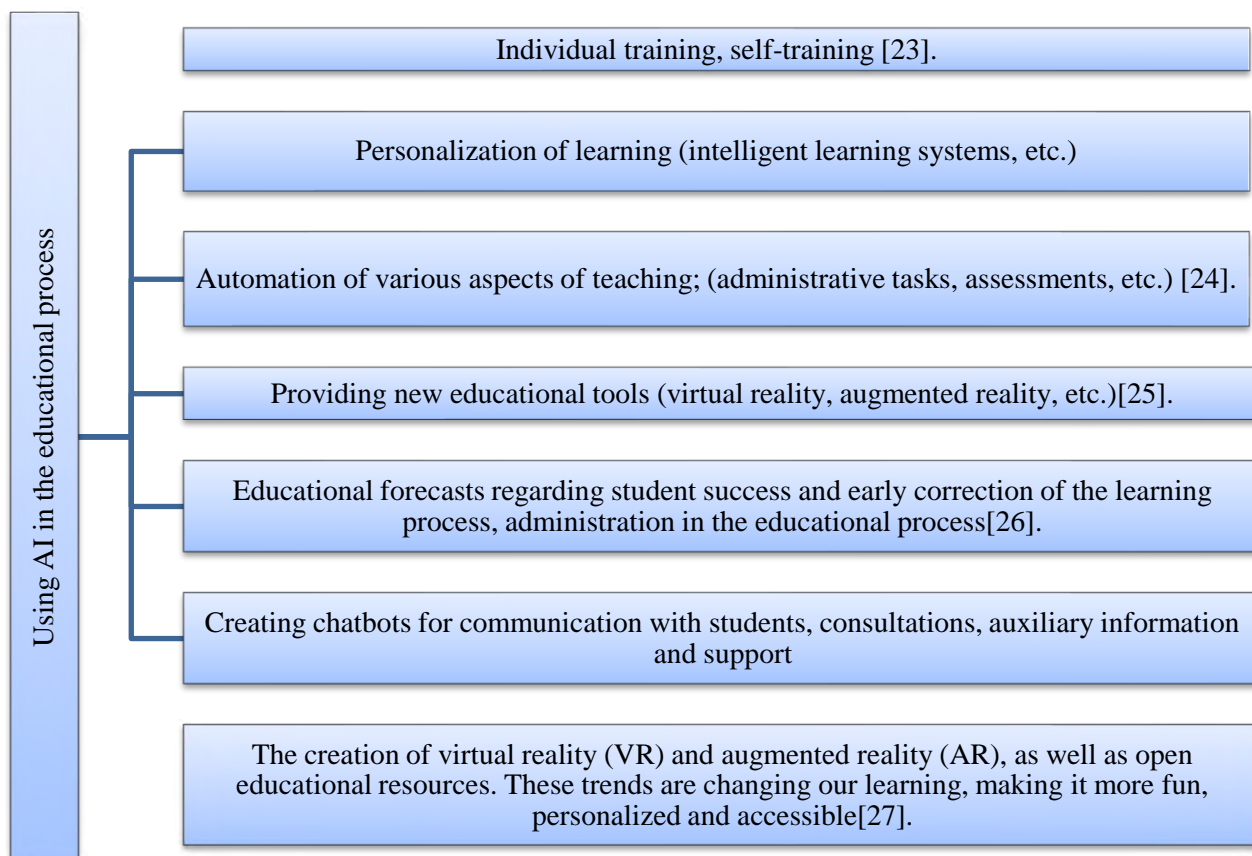
If, for example, we are talking about studying the discipline «Domestic Animal Anatomy» only with the help of Artificial intelligence, then the learning process is often accompanied by explanations or clarifications by the teacher of the questions considered in this task, since automated systems do not take into account the individual characteristics of students, their level of training and the questions context. In addition, Artificial intelligence is able to quickly analyze large amounts of information, but cannot always replace a live scientific discussion, a deep interpretation of complex biological processes and adaptation of the material to specific educational goals. That is why the most effective approach is to combine the capabilities of Artificial intelligence with the experience of a teacher who can explain the nuances, provide practical examples and help students develop critical thinking in studying the discipline «Domestic Animal Anatomy».

For example, we asked the Artificial intelligence the question: «Topography of the ethmoid bone» The Artificial intelligence answered that the ethmoid bone (os ethmoidale) is located in the area of the base of the skull between the frontal and sphenoid bones and forms part of the nasal cavity. However, if a student needs to clarify the features of its structure in different species of domestic animals (for example, the differences between a horse and a cow), or learn about its microscopic structure, the Artificial intelligence can give a general answer, but will not always take into account the specifics of the educational context. In this case, the teacher's explanation is indispensable, since he can: clarify the structure of the bone in different species of animals, explain its functional significance, use visual models or real anatomical samples. Thus, Artificial intelligence is a useful tool, but only in tandem with a teacher will the learning be full-fledged, deep and interactive. Some researchers believe that it is crucial to start introducing high school students to generative Artificial intelligence techniques as a tool for creation, while focusing on critical discussion of their social and ethical implications and encouraging proactivity in responsible consumers, creators, and stakeholders of technology [19]. There are a number of applications of Artificial intelligence in the educational process: automated assessment, automatic feedback, learning analytics, adaptive learning systems, intelligent learning systems, multi-label text classification, chatbots, expert systems, and mind-wandering detection. Most Artificial intelligence applications are used to support either knowledge formation or skill development [20, 21].

The study of preclinical disciplines, such as «Animal Physiology», «Domestic Animal Anatomy», «Cytology, Histology, Embryology», involves a number of classical methods of presenting new knowledge to the student, which include verbal (listening to words), auditory (reacting to animal sounds, language), visual (seeing animals, objects or images), physical (going through movement), interpersonal (exchange of ideas and points of view), logical (understanding reasons) and tactile/kinesthetic (touching objects). Moreover, classical forms of monitoring student work also include: checking workbooks (notes); assessing the content of knowledge and answers to typical tasks on topics; writing scientific papers and essays; using additional literature by the student; current and final control of knowledge in the form of an exam (module).

The use of Artificial intelligence tools can significantly simplify and expand the methodology of teaching preclinical disciplines to future veterinary doctors. Based on the fact that Artificial intelligence is able to monitor, model, analyze, interpret and transform data on the physiological and anatomical characteristics of productive animals and link them to various aspects of livestock production, which we conditionally divide into two categories: the first - animal health (clinical diagnostics, therapy, disease prevention, animal culling); the second - animal welfare and productivity (feeding, maintenance, ethology). And only basic programs for monitoring physiological parameters and anatomical characteristics ensure the operation of the system. Therefore, in our opinion, the primary task is to accustom the student to work with Artificial intelligence elements in the educational process, in the clinic and in production.

The use of Artificial intelligence in the studied disciplines «Domestic Animal Anatomy» can significantly improve understanding of the material, make learning more interesting and accessible. For example, virtual 3D models, programs and sites with 3D anatomy (for example, BioDigital Human, Zygote Body, Anatomica) that allow you to rotate, enlarge and view animal organs from all sides, augmented reality helps to superimpose 3D images on real space - you can study the structure of a cow or horse, simply by looking through a tablet or phone. Students can study in detail the structure of the skeleton, muscular system and internal organs of animals in real time. Artificial intelligence for image recognition - using neural networks to analyze X-rays, ultrasound, MRI helps to better understand the internal structure of animals. Google Lens and similar services can identify organs or body structures from a photo. Artificial intelligence chatbots can answer questions about the structure of the body, explain complex terms and even check knowledge with tests. Anatomy courses on Coursera, Udemy, Khan Academy often have built-in Artificial intelligence systems for personalized learning. For example, you can ask a GPT to create a comparison table of the anatomy of different animals. AI-based services (such as Synthesia) can create educational videos with virtual teachers (Fig. 1.).



**Fig. 1. General aspects of using Artificial intelligence in the educational process**

Much of the concern stems from concerns that students using these tools will hinder their ability to write and think critically. The socially irresponsible release of Artificial intelligence technologies tends to operate with relative impunity and without regard for the social consequences of their implementation [28]. By planning activities and using Artificial intelligence as an additional resource rather than a replacement for core skills, educators can help students expand and personalize their learning while maintaining standards of academic integrity.

Artificial intelligence platforms that can be used for the educational process [29]:

1. Sage Poe [<https://poe.com/Assistant.>]: a generative artificial intelligence search engine developed by Anthropic ©, which generates an answer based on the written data provided. Since July 2023, Quora has changed the name of Sage Poe to Assistant ©

2. Claude-Instant [ <https://poe.com/Claude-instant> ]: a more complex search engine that contains: a large number of different assistant platforms for different tasks, from video generation to text analysis, programming and of course learning.

3. ChatGPT version 3.5 [<https://poe.com/ChatGPT>]: an artificial intelligence search engine based on a generative architecture, developed by OpenAI © , trained on large and diverse data sets.

The principle of operation of the systems is similar. Question-answer or task - action.

*Example.* To study the dynamics of hormones in a cow.

*Artificial intelligence answer.* Here are five exercises for surveying students on the physiology of cow lactation:

*Exercise 1. Basics of lactation*

*Question:* Describe the process of lactation in cows. What are the main stages of this process?

*Exercise 2: Lactation hormones*

*Question:* What hormones are involved in the regulation of lactation in cows? What is the role of each of them?

*Exercise 3: The influence of nutrition.* (Note: a cow consumes feed, cow nutrition, feeding. The term nutrition does not apply to cows)

*Question:* How does the diet of cows affect their lactation? Name the main nutrients that are insufficient for optimal lactation.

*Exercise 4: Anatomy of the mammary gland*

*Question:* Describe the anatomical structure of the mammary gland of a cow. Which parts are related to milk production?

*Exercise 5: Pathologies of lactation*

*Question:* What are the main pathologies that can affect lactation in cows? How can they be diagnosed and treated?

– These questions certainly allow students to understand better the physiology of lactation in cows and put their knowledge into practice, however, the lack of adequate translation into Ukrainian may create difficulties in learning the material.

– The prospects for using Artificial intelligence in the educational process for veterinarians of preclinical disciplines are primarily as follows:

– Improving students' education and providing the opportunity to independently process a significant amount of information, providing educational information for effective teaching [30].

– Creating adaptive learning platforms, developing critical thinking skills in students or improving existing educational systems.

– Artificial intelligence provides exceptional accuracy in analyzing research results and high performance for a large data set, which makes it possible to train a student in researching large groups of animals using non-invasive methods (chips, sensors, thermographs, surveillance cameras, weather service data, feeders, etc.)

– Artificial intelligence is able to isolate results that go beyond the physiological or anatomical norm and contribute to faster and more detailed assimilation of the material.

Artificial intelligence tools are able to create a forecast of the development of the clinical picture and recommend ways to overcome or avoid pathology, which is extremely important for future doctors to practice. However, there is one significant caveat here, the capabilities of Artificial intelligence are limited by the availability of outdated data and access to current information, so the teacher's qualification at this stage of training is a decisive point [31]. Artificial intelligence can be used to generate tasks for assessing the level of knowledge in medical education [32].

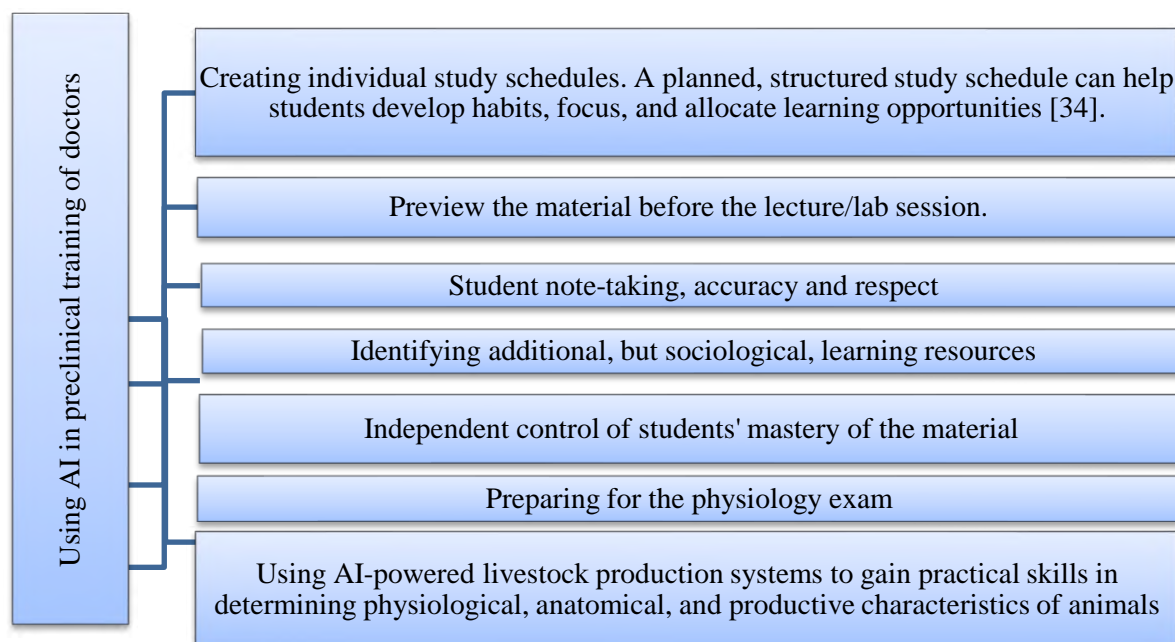
New modern trends have emerged, such as the use of AI, virtual reality (VR) and augmented reality (AR), as well as open educational resources (Fig. 2.). These trends are changing our learning, making it more fun, personalized and accessible [33].

An individual study schedule for the discipline «Animal Physiology» can create excellent opportunities for a deeper and more detailed mastering of the section, or the discipline as a whole. For example, with an individual study schedule, a prompt may appear that in a week you have a test on the section «Physiology of the Endocrine System», so you need to pay special attention to: general issues of humoral regulation and functioning of the hypothalamic-pituitary system; structure and structure of the endocrine system (anatomy and histology); pathological changes in the work of endocrine glands (pathological physiology); molecular mechanism of hormone action (biological chemistry); regulation of the development of productive qualities, growth and homeostasis; regulation of adaptation, regulation of reproduction. 30 minutes are offered daily for productive study.

The test covers two topics: «General physiology of the endocrine system» and «Physiology of individual endocrine glands». Artificial intelligence offers phased daily study of sections or 1-2 daily study of topics, the schedule can take into account 5-10 minutes of breaks between disciplines, with an individual choice of the daily «ideal time» for studying, taking into account other tasks in the subjects.

Previewing the material is an extremely important step for a better understanding of the endocrine system physiology, which allows you to form a general picture of endocrine regulation and creates a basis for a more detailed and in-depth study of the section. With the help of Artificial intelligence, the student has the opportunity to recall what has already been read in this area of knowledge and can use the mentioned

elements as components of a holistic picture of hormonal regulation. There may be several interesting landmarks for learning here.



**Fig. 2. Using artificial intelligence platforms to support student learning in preclinical disciplines [35]**

*For example:* What should I learn about the mechanisms of humoral regulation?

*Answer:* Humoral regulation is the mechanism of regulating various physiological processes in the body through hormones, which are produced by the endocrine glands. Hormones are distributed through the bloodstream and interact with various organs and tissues, causing necessary changes in the functioning of the body. Some examples include insulin, which regulates blood sugar levels, and adrenaline, which is responsible for the «fight or flight» response.

That is, the Artificial intelligence answer is a concise lecture summary that is easy to understand and absorb.

The teacher is fully aware that students' lecture notes can vary greatly, from an exact transcription of the lecturer's words to a summary of the lecture essence, sometimes with serious gaps in the text. Therefore, the use of AI supplements knowledge and identifies gaps in the material. AI can point out false statements and gaps in knowledge.

*For example:* Insulin is a hormone of the adrenal glands.

*Answer:* Insulin is a hormone that is produced by the pancreas, not the adrenal glands. The main function of insulin is to regulate blood glucose levels by stimulating cells to absorb glucose.

The identification of specialized additional learning resources allows students to significantly expand the base for obtaining and consolidating new knowledge, while physiology involves a comprehensive understanding of the issue, regardless of the species. The use of specialized chatbots also significantly improves the overall understanding of the issue.

*For example:* Welcome to GPTGO, your friendly Google search bot! How can I help you with your physiology today? Feel free to ask me any questions you may have about this topic.

*Example:* A specialized supplementary resource on endocrine physiology.

*Answer:* The best specialized supplementary resource on endocrine physiology is the web resource «EndocrineWeb» (<https://www.endocrineweb.com/>), which contains a wide range of information on diseases, diagnosis and treatment of endocrine disorders. This site also offers useful resources such as articles, news and tips for patients with endocrine problems.

*Example:* What are the three best videos for learning about the endocrine system?

*Answer:* 1. Understanding the Endocrine System: Hormones and Glands by Ninja Nerd Science 2. CrashCourse Biology #33: Endocrine System, part 1 3. The Endocrine System & Disorders: Crash Course A&P #23 by CrashCourse

Self-assessment during learning has been defined as a formative assessment process in which a student reflects on and evaluates the quality of their work and assesses their strengths and weaknesses in order to revise or change their learning behavior [36]. A direct proposal to assess a student's level of knowledge in a particular field of knowledge can also have a negative answer:

*Example.* As an artificial intelligence GPTGO, I cannot assess the knowledge of an individual. However, I am ready to answer your questions on the physiology of the endocrine system. What questions do you have?

However, there is always the possibility to check the correctness of the answer, as shown above. Or as follows: can you ask me a few questions about the endocrine system?

*Answer:* Of course! What aspects of the endocrine system are you interested in? This may relate to the work of specific organs, the production of hormones, the effect of hormones on body functions, and so on.

Exam preparation becomes much easier when using specialized platforms like Quizlet (<https://quizlet.com>), which are quite a serious tool for consolidating knowledge of specific profile knowledge. If someone suggests a chatbot to create a study guide, it will provide a list of key concepts and terms that need to be known, ask the student to outline any clinical meaning, provide practice questions and generate flashcards (the answer data is now shown). Perhaps an easier way for students to self-test is to give the Artificial intelligence the task of generating multiple-choice questions that require a certain degree of complexity [37]. The system allows you to connect to an online course, test your knowledge, or clarify terms and definitions.

#### *Use of Artificial intelligence in the field of human and animal health.*

Livestock production can contain a fairly significant number of application points of Artificial intelligence in the production process and animal health. This includes the use of AI methods for predictive veterinary and technical maintenance of livestock production and optimization of production cycles, feed production and livestock maintenance, herd monitoring and livestock selection, the use of robotics and production automation, and rapid response to current and global challenges. And this is certainly not a complete list of possible application points. The use of modern technologies in livestock and veterinary medicine involves the simultaneous monitoring of a huge number of different volumes of data.

The integration of Artificial intelligence in education and healthcare is a key advance in the dissemination of medical knowledge, especially for chronic diseases such as asthma. ChatGPT demonstrated significant expertise in conveying asthma knowledge, with flawless success in the etiology and pathophysiology categories and significant accuracy in medication information (70%). However, limitations were noted in medication-related responses, where mixed accuracy (30%) highlights the need to further improve ChatGPT's capabilities to ensure reliability in knowledge objectivity and up-to-date asthma knowledge. Reproducibility analysis demonstrated a consistent 100% score across all categories, confirming ChatGPT's reliability in providing consistent information [38].

Artificial intelligence (AI) technologies can help in creating adaptive agroecological management of livestock production [39]. Artificial intelligence AI are able to monitor, model, analyze, interpret and transform data on physiological and anatomical characteristics of productive animals and link them to different aspects of livestock production, which we divide into three categories:

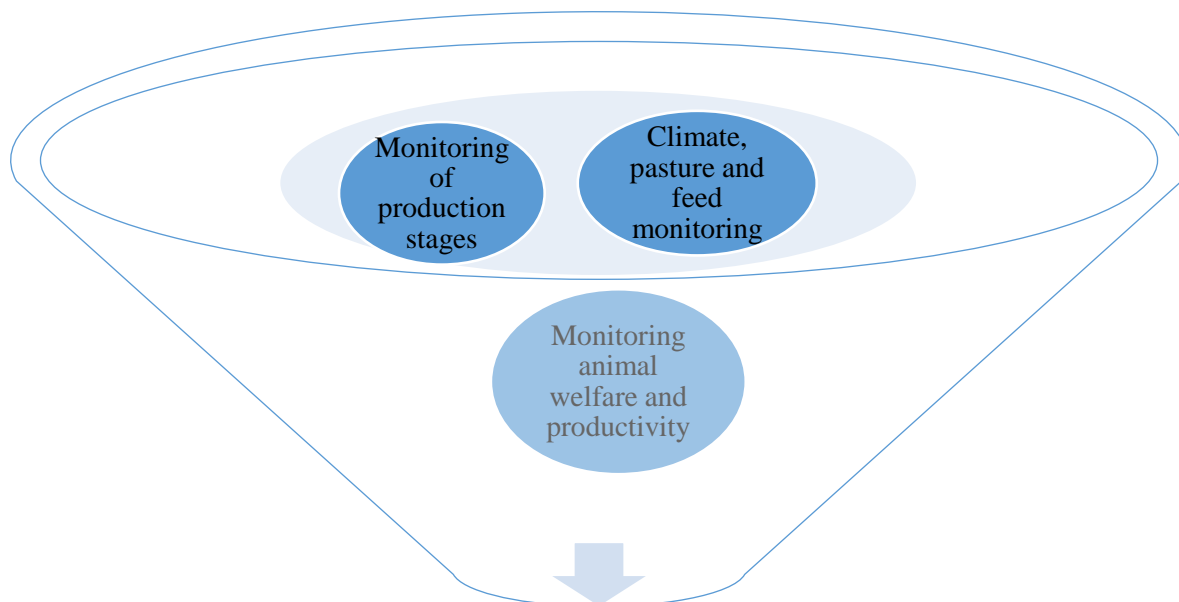
1. Animal health (clinical diagnostics, therapy, disease prevention, pharmacology, surgery),
2. Animal welfare (feeding, housing, ethology)
3. Economic efficiency of production.

The basis for using Artificial intelligence in livestock production to optimize production and ensure animal welfare is the availability of deep knowledge of preclinical disciplines among operators (Fig. 3.). Modern systems for monitoring the welfare and productivity of dairy cows are based on the following important components:

- Monitoring of motor activity (for example: time spent during the day on motor activity, aggressive interactions, food consumption, lying, standing, water consumption, sexual activity, searching for shaded places, gait abnormalities, behavior changes, etc.) and registration of individual and productivity, quality of the resulting product.
- Monitoring of temperature parameters, pulse, respiratory rate, thermographic images.
- Monitoring of external anatomical parameters of animals based on changes in body proportions (pregnancy, lameness, mammary gland size, forced postures, bloated fore-stomachs, etc. It is used to monitor the health of animals and detect signs of disease).
- Monitoring of automatic milking machines (determining the individual level of productivity of each cow, the ability to compare with previous ones and predict the next).
- Monitoring, robotic feed distribution systems (optimize feeding processes, automatically ensuring the feed needs of animals).
- Animal welfare monitoring (animal welfare monitoring helps reduce risks related to changing climate conditions).

It goes without saying, Artificial intelligence is an important tool for harmonizing the production of livestock products and can consider a number of important things. First of all, it is saving time and production resources, combined with ensuring animal welfare and solving agro-ecological problems, especially in times of climate change. In addition, Artificial intelligence tools allow you to raise healthier animals and produce higher quality products [40].





**Fig. 3. Using AI to manage livestock production**

A wide range of livestock producers today no longer need to maintain many qualified workers for keeping, feeding, reproduction, detecting animals on the territory, their classification and individual identification, determining the level of welfare and productivity. Artificial intelligence provides the possibility of adaptive process management in production, but at this stage, the low number of specialists who are able to comprehensively assess the state of welfare of productive animals and develop directions for its improvement based on monitoring production processes, photo and video recording of anatomical parameters, and physiological parameter data is quite critical.

The use of Artificial intelligence in veterinary clinics (registration, laboratory tests, diagnostic measures and treatment, prognosis, rehabilitation and diet and prevention, quarantine, etc.) is somewhat separate. First, it is necessary to teach future personnel basic concepts and instill in them appropriate skills. And secondly, the question of both the competence of a veterinary specialist and his ability to think critically is acute, because the use of outdated or inadequate databases by Artificial intelligence tools can lead to erroneous conclusions. Perhaps some databases need to be limited in training and then the repeatability of recommendations will be more adequate. Veterinary medicine should also change its ethical principles of veterinary practice to take into account the numerous problems associated with the use of Artificial intelligence systems in animal health care [41].

It is very important that teaching students the methodology of using Artificial intelligence in animal husbandry based on obtaining sustainable knowledge from preclinical disciplines creates an opportunity not only to ensure the welfare of productive animals, but also contributes to improving the agroecological situation in a given agroecosystem. The use of the R-packages *camtrapmonitoring* (<https://github.com/robital/ec/camtrapmonitoring>) and *cameratrappgridR* (<https://github.com/CameraTrapDetectoR/cameratrappgridR/>) for monitoring animal health in production is controversial, but they are indispensable in training veterinarians in wildlife monitoring. Computer vision models are increasingly entering human life; there are entire scientific areas that serve the needs of ecologists, zoologists, and other specialties, all of which are based on the anatomical and physiological characteristics of the species. Conservation X Labs' Sentinel Camera (<https://sentinel.conservationslabs.com/>) uses customized object detection models and adapted hardware to provide real-time notification capabilities in a variety of settings, including livestock monitoring, with full technological support. NanoDetector (<https://nanodetector.ai>), developed by the University of Idaho in collaboration with the Wildlife and Humans in Shared Landscapes project (<https://whisl.org>), also deploys custom Artificial intelligence models on devices to detect and classify animals and notify users in real time using open source software and off-the-shelf commercial hardware. [42].

So many scientists are engaged in the analysis of the physical characteristics of commercial eggs in order to use Artificial intelligence to help improve their quality, productivity, and marketability [43].

Thus, the analysis of modern literature does not provide a complete picture of the possibilities of using Artificial intelligence in the educational process, perhaps soon new methodological approaches will appear based on Artificial intelligence, but today there is an urgent need for its use in production, and the training of such specialists is a new task of university education.



**Conclusions.** Artificial intelligence is gradually becoming an integral part of our lives. Its use allows us to improve medicine, finance, transportation, education and many other areas. Despite challenges such as ethical issues and job security, one thing is clear - Artificial intelligence is here for the long term, and its impact will only grow. University teachers need to consider the possibility of including elements using artificial intelligence in their curricula in three main areas: self-training, self-analysis and planning of the educational process; the use of Artificial intelligence tools in teaching basic preclinical disciplines (physiology, anatomy and histology); the use of Artificial intelligence in the production of livestock products (monitoring animal welfare and productivity; monitoring animal health; planning veterinary preventive and therapeutic measures).

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## **ПЕДАГОГІЧНІ УМОВИ ФОРМУВАННЯ ОСНОВНИХ ПРОФЕСІЙНИХ КОМПЕТЕНЦІЙ У МАЙБУТНІХ БАКАЛАВРІВ ІНЖЕНЕРНО-ТЕХНІЧНОГО ПРОФІЛЮ В ПРОЦЕСІ ВИВЧЕННЯ ПРИРОДНИЧИХ ДИСЦИПЛІН**

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**Леся ЗБАРАВСЬКА**

кандидат педагогічних наук, доцент

Заклад вищої освіти «Подільський державний університет»

e-mail: olzbaravska@gmail.com

**Ірина ЯСІНЕЦЬКА**

доктор економічних наук, професор

Заклад вищої освіти «Подільський державний університет»

e-mail: kinash.irina@meta.ua

**Вступ.** Глобальний перехід до інформаційного етапу розвитку значно впливає на соціально-економічні, культурні та освітні аспекти життя в Україні. Проте промисловість і сільське господарство залишаються основними складовими добробуту народу та основою державного розвитку. Застарілі технології в агросфері та нестача висококваліфікованих спеціалістів перешкоджають цим галузям конкурувати з іноземними компаніями. Ситуацію можуть змінити сучасні випускники аграрно-технічних університетів — компетентні фахівці нового покоління, здатні розробляти і впроваджувати інновації, такі як інтегровані агротехнології, 3D-моделювання, комп'ютеризоване моделювання та виробництво деталей і конструкційних матеріалів за допомогою нанотехнологій. Згідно з чинним освітнім законодавством України (Закон «Про вищу освіту», Національна стратегія розвитку освіти до 2025 року), вітчизняна професійна освіта повинна зосереджуватися на формуванні професійної компетентності майбутніх фахівців. Це дозволить їм оперативно реагувати на зміни в професійній діяльності та суспільних процесах, а також забезпечить можливість самостійного здобуття професійних навичок протягом всього життя.

Для ефективної підготовки спеціалістів інженерно-технічних спеціальностей в університетах України необхідно враховувати інноваційний характер сучасних наукових досягнень та освіти, прискорений розвиток технологій і потребу у готовності до змін, а також створити умови для особистісного зростання та безперервного професійного вдосконалення. Формування професійної компетентності у майбутніх бакалаврів інженерно-технічних спеціальностей, зокрема під час вивчення науково-природничих дисциплін, відіграє важливу роль у цьому процесі. Основні професійні компетенції охоплюють розвиток мотивації до формування особистісних якостей, освоєння навичок самоосвіти та професійного самовдосконалення при опануванні основних знань і вмінь. Професійна компетентність майбутніх агроінженерів є визначальною для розуміння технічних інновацій і освоєння спеціалізованих компетенцій, що дозволяють ефективно вирішувати проектно-конструкторські, виробничо-технологічні та дослідницькі завдання в їхній професійній діяльності.

Сьогодні науковці активно досліджують формування професійної компетентності майбутніх фахівців у ЗВО в різних аспектах. Теоретико-методологічні основи модернізації вищої освіти України, її входження в європейський простір заклали, Н. М. Бібік, С. У. Гончаренко, Р. С. Гуревич, І. А. Зязюн, А. М. Коломієць, В. В. Краєвський, В. І. Луговий, І. П. Підласий, О. С. Пономарьов, О. Г. Романовський, Т. І. Туркот та ін. Вдосконаленням вищої професійної освіти та розглядом