

ChatGPT for Veterinary Anatomy Education: An Overview of the Prospects and Drawbacks

ChatGPT para la Educación en Anatomía Veterinaria: Una Descripción General de las Perspectivas y los Inconvenientes

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SUMMARY: The integration of artificial intelligence in veterinary medical education has the potential to revolutionize the way students learn veterinary anatomy. ChatGPT, launched by OpenAI in November 2022, has been the fastest-growing artificial intelligence (AI) application as a learning tool in the past few months. ChatGPT is a virtual assistant that provides students with detailed and relevant anatomical knowledge based on internet sources. Apart from the advantages of ChatGPT in veterinary anatomy education, the challenges and limitations must also be considered, as highlighted in this letter. Further research and evaluation are necessary to ensure the optimal integration of the ChatGPT tool into veterinary anatomy education. ChatGPT can provide students with valuable insights and educational support but cannot replace hands-on experiences; dissection-based laboratory sessions remain essential for developing practical skills and spatial understanding in veterinary anatomy education.

KEY WORDS: Veterinary anatomy education; ChatGPT; Artificial intelligence; Prospects; Drawbacks.

INTRODUCTION

ChatGPT (Generative Pretrained Transformer), an innovation of OpenAI (San Francisco, CA, USA), was released in November 2022 (Liebrez *et al.*, 2023; Sedaghat, 2023) and reached one million users in a few short days. OpenAI's ChatGPT language model uses deep learning to produce human-like responses to text-based inputs. The model can comprehend and answer numerous queries in a natural language style because it has been trained on vast internet-sourced data. People across different fields, generations, and continents started using ChatGPT, increasing its popularity continuously (Aydn & Karaarslan, 2023). A sophisticated chatbot can handle lengthy discussions, comprehend context, and produce adequate responses. Medical and veterinary education are only two of the many areas of our society that artificial intelligence (AI) is revolutionizing. Chatbots are becoming increasingly common in medical education, and ChatGPT is one of the most advanced AI-powered chatbots. Chatbots and GPT-based models can significantly impact the learning and understanding veterinary anatomy.

During the COVID-19 pandemic, the virtual approaches for teaching impacted veterinary anatomy education with the onset of e-learning globally used and shared by anatomists (Choudhary, 2021a,b,c; Kapoor & Singh, 2022). This collective experience has led to some calls to further integrate AI into anatomy education as an ongoing standard teaching tool, with select groups of students and educators valuing these technological advances over traditional person-led teaching approaches like dissection. Given this contemporary interest in supporting artificial intelligence-infused anatomy education (AIED), this article explores the question: To what extent can existing AI enhance and/or support effective anatomy education? (Lazarus *et al.*, 2022). We have designed this letter on ChatGPT to express the prospects and drawbacks of this novel AI technology in veterinary anatomy.

- i. Visual representation: Chatbots can visually represent anatomical structures like interactive diagrams or three-dimensional (3D) models. These visuals can help students

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- visualize complex anatomical concepts, understand the relationships between different structures, and improve their spatial understanding. The 3D model feature is not available in the ChatGPT; however, with technological advancement, it needs to be included in the ChatGPT in the future.
- ii. Interactive learning: GPT-powered chatbots can engage in interactive conversations with students, allowing them to ask questions about specific anatomical structures or systems. The chatbot can provide detailed descriptions, definitions, and explanations, helping students grasp the intricacies of veterinary anatomy conversationally.
 - iii. Accessible reference materials: Chatbots can readily be available for veterinary students, providing quick access to anatomical information. Students can ask the chatbot about the location, function, and clinical relevance of specific anatomical structures, which can be particularly useful during study sessions, practical examinations, or when preparing for surgeries.
 - iv. Comparative anatomy: Veterinary anatomy often involves studying the anatomical differences between animal species. Chatbots can facilitate comparative anatomy by offering information about specific anatomical variations and highlighting the unique aspects of each species. In addition, students can explore the similarities and differences between animal anatomies through interactive conversations.
 - v. Case-based learning: GPT-powered chatbots can present case scenarios or clinical cases involving anatomical abnormalities or pathologies. Students can discuss with the chatbot, analyzing the anatomical implications of the cases and applying their knowledge to diagnose and propose treatment options. This approach can enhance critical thinking and problem-solving skills in the context of anatomy.
 - vi. Reinforcement of key concepts: Chatbots can reinforce key anatomical concepts through interactive quizzes, flashcards, or review sessions. Students can test their knowledge, identify areas of weakness, and receive immediate feedback. This repetitive reinforcement can help solidify their understanding of veterinary anatomy. Some of the features are not available presently in the ChatGPT, which are present in other chatbots; however, the missing features need to be updated in the ChatGPT in the future.

The prospects and drawbacks of the ChatGPT application are summarized in Figure 1. Apart from the above prospects of ChatGPT in veterinary anatomy education, we have recorded some responses to questions using ChatGPT. We have not edited the responses generated by the ChatGPT and, as such, summarized them in Table I.

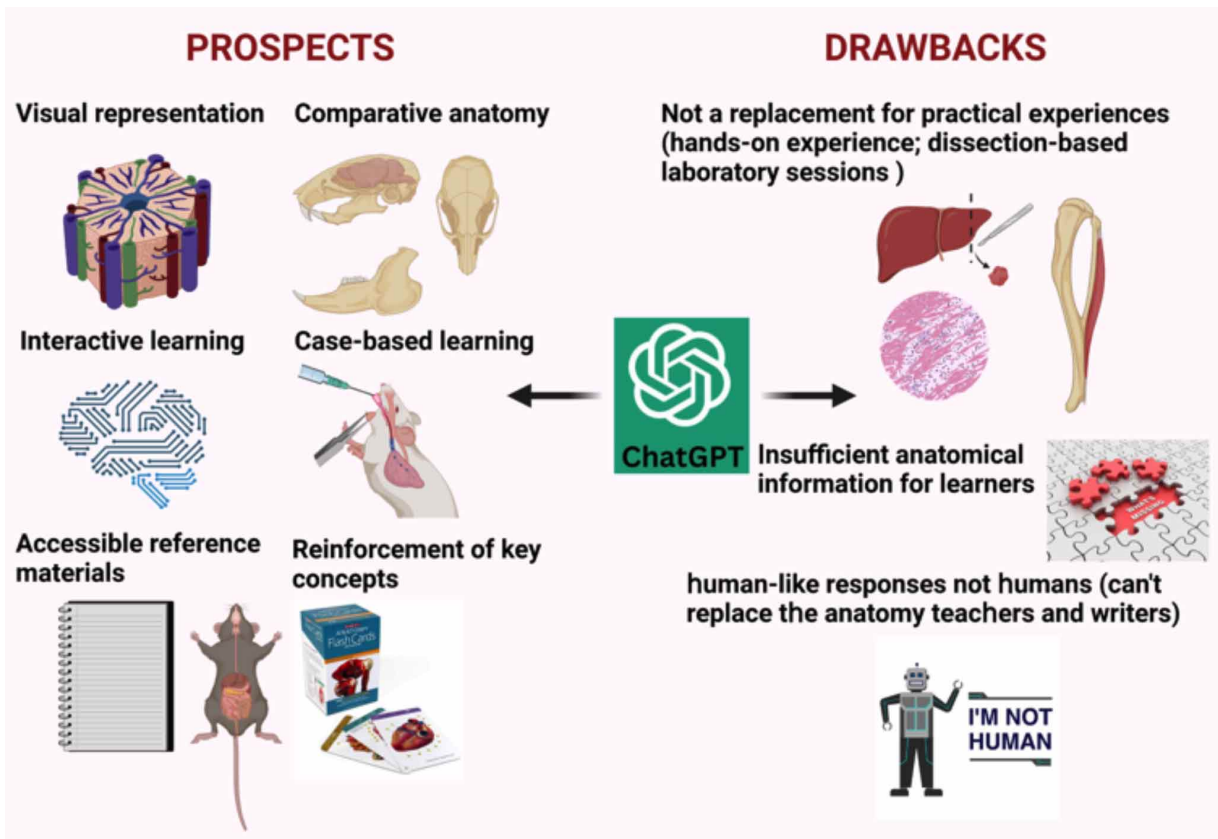


Fig. 1. Illustration showing prospects and drawbacks of the new AI technology ChatGPT for veterinary anatomical education.

Table I. Questions asked along with the responses received from the ChatGPT.

Sl. No.	Prompts	ChatGPT responses
1.	What is veterinary anatomy?	<p>Veterinary anatomy is a branch of anatomy that focuses on the structure and organization of the body of animals. It specifically deals with the study of the anatomical features, including the organs, tissues, bones, muscles, nerves, blood vessels, and other structures, in various animal species.</p> <p>Veterinary anatomy plays a crucial role in understanding the normal structure and function of animals' bodies. It provides the foundation for diagnosing and treating diseases, performing surgical procedures, and conducting research in veterinary medicine.</p> <p>In veterinary anatomy, different animal species are studied, including domesticated animals such as dogs, cats, horses, and livestock (cattle, sheep, pigs, etc.), as well as wildlife and exotic animals. Comparative anatomy, which involves comparing the anatomical structures of different species, is also an important aspect of veterinary anatomy.</p> <p>Veterinary anatomists use various techniques and methods to study animal anatomy, including dissection, imaging technologies such as radiography and ultrasound, and advanced techniques like computed tomography (CT) and magnetic resonance imaging (MRI). They also utilize anatomical models, charts, and illustrations to aid in teaching and understanding the complex structures of animals.</p> <p>Overall, veterinary anatomy provides a fundamental understanding of the anatomical basis of animal health and disease, helping veterinarians and veterinary professionals in their clinical practice and research endeavors.</p>
2.	Enlist the bones of the forelimb in an ox.	<p>The forelimb of an ox (also known as a cow) consists of several bones that provide support, movement, and protection. The major bones of the forelimb of an ox include:</p> <p>Scapula (Shoulder blade): This flat, triangular bone forms the shoulder joint and provides attachment sites for muscles involved in shoulder movement.</p> <p>Humerus: The humerus is the bone of the upper arm. It extends from the shoulder joint to the elbow joint and articulates with the scapula and the bones of the lower arm.</p> <p>Radius: The radius is one of the bones of the lower arm. It runs parallel to the ulna and extends from the elbow joint to the carpus (wrist) joint.</p> <p>Ulna: The ulna is the other bone of the lower arm. It runs parallel to the radius and extends from the elbow joint to the carpus (wrist) joint.</p> <p>Carpal Bones: The carpal bones, also known as the wrist bones, form the carpus joint. There are two rows of carpal bones in oxen, with the proximal row consisting of the radial, intermediate, and ulnar carpal bones, and the distal row consisting of the accessory, fourth, and third carpal bones.</p> <p>Metacarpal Bones: The metacarpal bones are long bones that extend from the carpus to the digits (fingers) of the ox's hoof. Oxen have two functional metacarpal bones, commonly referred to as the cannon bones. These are referred to as the third and fourth metacarpal bones.</p> <p>Phalanges: The phalanges are the bones of the digits (fingers) and hoof. An ox has two phalanges in each digit, except for the innermost digit, which has one phalanx. The phalanges are labeled as proximal, middle, and distal phalanges.</p> <p>It's important to note that there can be some individual variation in the exact number and arrangement of bones, but the aforementioned bones provide a general overview of the forelimb bones of an ox.</p>
3.	What is the site for medial patellar desmotomy in large ruminants?	<p>Medial patellar desmotomy, also known as medial patellar ligament release, is a surgical procedure performed in large ruminants such as cattle to correct patellar fixation or upward fixation of the patella. It involves cutting the medial patellar ligament to release the fixation.</p> <p>The specific site for medial patellar desmotomy in large ruminants is the medial aspect of the patellar ligament, just above the tibial tuberosity. This is typically accessed through a small surgical incision made on the medial side of the stifle joint (knee joint).</p> <p>It's important to note that performing surgical procedures on large ruminants requires proper training, expertise, and veterinary supervision. If you suspect an issue with patellar fixation in your livestock, it is recommended to consult with a veterinarian who can assess the condition and provide appropriate guidance and treatment.</p>
4.	What are the branches of the facial nerve in the middle ear?	<p>In the middle ear, the facial nerve, also known as cranial nerve VII, gives rise to two important branches. These branches are:</p> <p>Chorda Tympani: The chorda tympani is a branch of the facial nerve that passes through the middle ear. It carries taste sensations from the anterior two-thirds of the tongue and provides secretomotor innervation to the sublingual and submandibular salivary glands.</p> <p>Nerve to Stapedius Muscle: This branch supplies the stapedius muscle, which is located within the middle ear. The stapedius muscle plays a role in dampening excessive vibrations of the stapes bone in response to loud sounds.</p> <p>These branches are significant for their roles in taste perception and the control of certain muscles within the middle ear. It's important to note that the branches and their distribution can vary slightly among individuals, but these two branches are typically present in the middle ear as major offshoots of the facial nerve.</p>

The first question we asked was, "What is veterinary anatomy". The response from the ChatGPT provided five definitions and is found to be quite similar to the definitions mentioned in the textbook of veterinary anatomy (Singh, 2017). Therefore, as discussed in this article, The ChatGPT

may be appropriate for learning veterinary anatomy for students with limitations.

The second question we asked was, "Enlist the bones of the forelimb in ox". The response provided by the

ChatGPT covered all the forelimb bones except proximal and distal sesamoid bones present at the level of the fetlock and coffin joints in the ox (Getty, 1975). Moreover, the statement “ox (also known as a cow)” is not appropriately provided by the ChatGPT.

The third question we asked is related to applied anatomy i.e., “What is the site for medial patellar ligament desmotomy (MPD) in large ruminants?”. In the first paragraph, the answer provided by the ChatGPT discussed how the clinical condition associated with MPD is to be treated in animals which corroborates with the findings of Naveen *et al.* (2014). In the second paragraph, the response provided by the ChatGPT is “for performing the MPD surgery is the stifle joint (knee) joint”, which is a scientifically inappropriate statement as the knee joint is present in the forelimb of animals; hence the terminologies related to veterinary anatomy requires to be updated in the ChatGPT in the future. The stifle joint is present in the hindlimb of the animals and differs anatomically from the knee joint. It seems ChatGPT provides scientific information by clubbing human and animal data on internet sources, which can hamper anatomy learning for medical and veterinary anatomy students. The third paragraph discusses the surgical site for the MPD. Most importantly, the site is significant because a slight nicking of the middle patellar ligament did not produce any noticeable lameness in the animals (Dollar, 1895). An accidental complete transection of the middle patellar ligament renders the animal permanently lame (Sahu, 1971).

The last question we asked is, “What are the branches of the facial nerve in the middle ear?” similar to the previous question asked by Mogali (2023). However, we have noticed that the responses we received compared to the Mogali (2023) were completely different. Hence there may be variations in the responses generated by the ChatGPT as it uses vast internet-sourced data.

Conclusively, the responses generated from the ChatGPT can serve the new AI technology that can be revolutionized. Also, the responses by the ChatGPT were only in text format, without any scientific images or videos that can support the text for better understanding and learning the anatomical structures. AI technologies like ChatGPT should not replace practical experiences, dissections, or hands-on learning opportunities. While chatbots such as ChatGPT can provide valuable supplementary resources and support, direct observation and practical application of anatomical knowledge remain crucial in veterinary education. Therefore, ChatGPT is still a novel and early-stage application that needs further improvements to be widely used in veterinary anatomy education.

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RESUMEN: La integración de la inteligencia artificial en la educación médica veterinaria tiene el potencial de revolucionar la forma en que los estudiantes aprenden anatomía veterinaria. ChatGPT, lanzado por OpenAI en noviembre de 2022, ha sido la aplicación de inteligencia artificial (IA) de más rápido crecimiento como herramienta de aprendizaje en los últimos meses. ChatGPT es un asistente virtual que brinda a los estudiantes conocimientos anatómicos detallados y relevantes basados en fuentes de Internet. Además de las ventajas de ChatGPT en la educación en anatomía veterinaria, también se deben considerar los desafíos y las limitaciones, como se destaca en esta carta. Se necesitan más investigaciones y evaluaciones para garantizar la integración óptima de la herramienta ChatGPT en la educación en anatomía veterinaria. ChatGPT puede proporcionar a los estudiantes información valiosa y apoyo educativo, pero no puede reemplazar las experiencias prácticas. Las sesiones de laboratorio basadas en disecciones siguen siendo esenciales para desarrollar habilidades prácticas y comprensión espacial en la educación de la anatomía veterinaria.

PALABRAS CLAVE: Educación en anatomía veterinaria; ChatGPT; Inteligencia artificial; Perspectivas; Inconvenientes.

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