

# Veterinary Anatomy During the COVID-19 Pandemic in Brazil: Research Focused on Pedagogical Practice

Anatomía Veterinaria Durante la Pandemia COVID-19 en Brasil:  
Investigación Centrada en la Práctica Pedagógica

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**SUMMARY:** Since the first Brazilian Veterinary Medicine course in 1910, many curricular changes have taken place. The pedagogical project have been centered on the student as a subject of learning and supported by the professors as a critical mediator of this process and the pandemic of COVID-19 accelerated this change. Many professors have taught video lessons to ensure continuity of teaching, research and extension, even at a distance. This paper, therefore, aims at reporting the development of animal anatomy didactic contents applied on online platforms in Portuguese language. To this, eight researches were developed addressing the teaching-learning of Morphological Sciences contents to be incorporated into distance education platforms that focused canine and feline anatomy, the study of neuroanatomy in the ovine, bovine, equine and primate species and the surgical anatomy of the locomotor apparatus of the equine specie. Thus, virtual teaching-learning platform can help, as a complementary tool to face-to-face classes, in obtaining the skills, abilities and attitudes required for the training of veterinary students in Brazil.

**KEY WORDS:** Veterinary education; Distance education; Online platforms.

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## INTRODUCTION

In Brazil, since 1910, in the first year of the Veterinary Medicine course, university chairs of comparative anatomy of small animals and descriptive anatomy of the ox and horse with dissection practices had already been established (Capdeville, 1991). Since then, many curricular changes have been occurred in Veterinary Medicine, with the valorization of soft skills, such as decision-making, communication, leadership in multi-professional teamwork, management and permanent education of individuals capable of learning. This pedagogical project started to be centered on the student, as a subject of learning and supported by the professor as a critical mediator of this process. In 2020, the Veterinarian was finally recognized as an essential professional for disease control in the country (Brasil, 2020).

However, the rapid spread of the new coronavirus

across the world has culminated in a major impact on the economic, social and educational development of all countries (Heymann & Shindo, 2020; Rodriguez-Morales *et al.*, 2020). Brazil also experienced social isolation due to COVID-19 and many professors have taught video lessons to minimize a possible academic gap and ensure continuity of teaching, research and extension activities, even at a distance.

In an attempt to find adequate forms in the area of education, Brazilian Veterinary Anatomy also takes into consideration the above experience. This paper aims to report the development of animal anatomy didactic contents applied on online platforms in Portuguese language, addressing the new strategies that contribute to the progress in teaching and learning during coping with COVID-19.

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## MATERIAL AND METHOD

This research is qualitative and descriptive in nature. Eight studies were developed in the Postgraduate Program in Anatomy of Domestic and Wild Animals of the School of Veterinary Medicine and Animal Sciences (FMVZ) of the University of São Paulo (USP), addressing the teaching-learning of Morphological Sciences contents to be incorporated into distance learning platforms.

## RESULTS

We present eight academic thesis bellows. It is based on the complex form-function and its multiple implications to fulfill the mission of training M. Sc. and Ph.D. anatomists capable of proposing original ideas, and of using new technologies that contribute to the solution of problems inherent to the great challenges of contemporary science. The contents were created as a tool to support and complement the study of the discipline of veterinary anatomy.

“Animal anatomy teaching platform: didactic content for virtual learning environment and 3D printing as an anatomical technique” adopted canine (*Canis lupus familiaris*) as anatomical model for developing didactic content for the virtual learning environment in Veterinary Medicine. For this, nine modules were based on *Nomina Anatomica Veterinaria* and contemplated: Introduction to Veterinary Anatomy; Osteology; Arthrology; Myology; Splanchnology; Angiology; Nervous System; Sense Organs; and, Common Tegument. Each module included nine following training steps: quiz, didactic text, glossary, video lessons, 3D print, application to diagnostic imaging, clinical case study, final evaluation and satisfaction survey. For the 3D printing of biomodels, canine anatomical parts were scanned, using computed tomography, to create the prototypes in ABS material (acrylonitrile butadiene styrene). As a result of this work, the modules developed were hosted in Google Classroom.

“Development of an interactive tool for the study of the central nervous system in sheep”: Contains the content referring to veterinary neuroanatomy, the model species used was the sheep. The module was divided into five classes that include an introduction to veterinary neuroanatomy, a brain class (telencephalon and diencephalon), a brain stem class, a cerebellum and spinal cord class, and a class on the main neurological diseases in sheep. Each class includes an atlas, a book in PDF format and a video class. All images in the atlas were obtained by photo-accumulation of slides in

cross-sections of the brain and spinal cord of the sheep model. The structures were described and identified in a rostrocaudal sequence and hosted on an online platform.

“Development of a multidisciplinary teaching and learning tool in equine neuroanatomy” used a collection of transverse slides from the brain and spinal cord of the equine model. The objective was to describe the structures neuroanatomical and associated with neurological syndromes of this species. A website prototype was developed to host the content.

“Structuring of a teaching platform related to the anatomical constitution of the central nervous system of the Capuchin monkey (*Cebus apella*)” presented contents of neuroanatomy of non-human primates. In this platform, descriptions of structures and functions related to Capuchin monkey neuroanatomy were added. The structures were correlated with the neurological syndromes and clinical signs of the species.

“Multidisciplinary Interactive Digital Platform for Bovine Neuroanatomy” prepared slides in cross-sections of the brain and spinal cord of *Bos taurus*. The platform was structured with the following contents: development, division and organization of the nervous system; neurocranium and cranial nerves; spinal cord, spinal nerves and meninges; brain cavities and vascularization; brain, cerebellum and brain stem; autonomic nervous system; nerve pathways; brain sections atlas; anatomical clinical correlations and plastination.

“Digital platform: complementary teaching-learning method of comparative embryology focusing on the cardiovascular system” developed instructional material about the developmental anatomy, focusing on the cardiovascular system of *Gallus gallus domesticus*.

“Interactive multidisciplinary digital atlas of functional neuroanatomy of the cat” conducted the scanning of the central nervous system microscope slides collection of *Felis catus*. After the scanning, an interactive multidisciplinary digital atlas of feline functional neuroanatomy was created. Its interactivity is based on the preparation of central nervous system images with identification of structures, establishing when possible correlation with the clinical neurological content documented, by videos of animals with neurological syndromes.

“Development of a distance learning platform for surgical anatomy of the equine locomotor system, as a complementary tool for training in veterinary surgery” is under development and aims at addressing the main surgical

procedures in *Equus caballus*. So far, the content includes the anatomy of the digit, which consists of a theoretical description, images, diagrams, drawings and video lessons.

## DISCUSSION

We are facing an educational pandemonium, undoubtedly experienced by most universities. Adaptations for the classes were necessary, and the scientific research carried out in the Postgraduate Program in Anatomy of Domestic and Wild Animals FMVZ-USP focused on the theme of the remote teaching-learning process.

Since the beginning of the pandemic, several studies have been focused on guiding the teaching of anatomy through videos and online platforms. Many authors have suggested that digital resources will remain an integral part of anatomical education even after the COVID-19 pandemic. (Alshari *et al.*, 2020; Mahdy, 2020; Taha *et al.*, 2020; Zhou *et al.*, 2020).

Thus, we affirm that distance learning assumes its role in the face of animal anatomy, becoming an alternative (complementary and not a substitute) to traditional classrooms. If, at the beginning of the 21<sup>st</sup> century, studies on quality in distance education focused on three pillars, considered as an essential triad to offer a quality course (didactic material, tutoring and evaluation), today we believe in the emergence of a new pillar: the method used in classes. To this, the didactic contents applied on online platforms in Portuguese language developed in the present research, can be used as an active learning approach, such as the flipped classroom, that could be linked to better outcomes for medical students, with the potential to provide support in the preparation for practice. In the instructional approach of this method, students engage in meaningful pre-class to learn fundamental knowledge, skills and attitudes and then can carry out instructional activities in a traditional laboratory that compel them to integrate, apply and extend the content from discipline to new contexts. Pre-class activities generally include a review of teaching materials through guiding questions of preparatory learning, such as surveys, case studies and problem-solving through a reflective assignment. In addition to the flipped classroom benefiting the students' learning, it also benefits the teaching staff involved with students who have already had some previous virtual contact with the subject to be taught (Fleagle *et al.*, 2018; Matthew *et al.*, 2019; Sandrone *et al.*, 2020).

In this context, our results confirm that the increasing complexity of the current educational problems induces the

use of different forms of articulation between the disciplines in multi, pluri, trans and interdisciplinary approaches for their solution. However, e-learning and b-learning platforms must be used with caution to not collaborate with traditional professor-centered teaching models, where the website functions as a slide repository, but rather to create a pedagogical model that guarantees collaborative learning centered in the student. At this point, flipped classrooms can be the key to provide students with sufficient autonomy to seek knowledge with ethics and responsibility (Ferreira, 2014).

Despite so many challenges, in the last times of confrontation with COVID-19, the university mission continues to be to train empathetic students, responsible for public health and with technical excellence. As the disease progresses, its educational impact is highly uncertain and this makes it difficult to predict the academic performance of students in a virtual learning environment. However, it is challenging for professors to reformulate the curricular structure, integrating technology to minimize the losses caused by the impossibility of having face-to-face classes during this troubled moment in the history of education. However, we suggest taking into account the learning cycle of Kolb (2014), which owes its origins to the works of Lewin, Dewey and Piaget; in this theory, students have a concrete experience, on which they must carry out a reflexive observation which will lead them to develop an abstract conceptualization, tested through active experimentation. This cycle then feeds another cycle of concrete experience, and so on. The model recognizes the need for students to develop theories, apply them to real problems, evaluate the results and, later, refine their academic understandings. Experiential learning, therefore, supports the development of superior cognitive skills and allows students to apply and practice what they have learned through authentic clinical contexts (Kerr *et al.*, 2013).

Therefore, the solution certainly is to reformulate the teaching method instead of cutting contents. Blended learning (b-learning) derives from e-learning, being a hybrid teaching method (semi-face-to-face), that is, it relies on both information and communication technology and face-to-face classes to train better prepared students. The virtual contents can be applied in a flipped classroom which is a modality of b-learning. However, we note here that educational platforms are complementary alternatives and, never, substituting the classic dissection of cadavers (Plendl *et al.*, 2009; Ryan *et al.*, 2009; Bernkopf *et al.*, 2010; Johnson *et al.*, 2013).

Undoubtedly, spending a lot of time concentrated on the Internet makes students lose motivation to participate in classes, in addition to feeling tired, sleepy or feeling lonely. Among the recommendations of the students themselves

regarding the improvement of online learning, is the fact that universities provide distance learning platforms with easy access to study materials (Mahdy, 2020). It is also important to have a critical view that virtual education requires significant investment from institutions (Wilcha, 2020). Among all this, Anatomy has been at the center of medical education and scientific research for many centuries and, therefore, there is no reason why this should not continue in the future (Brassett *et al.*, 2020).

## CONCLUSION

It is believed that it is possible that the teaching of Anatomy of Domestic and Wild Animals, in the distance modality, understood as complementary (and never substituting) in relation to face-to-face classes, fulfills with the purpose of offering tools to students enrolled in Veterinary Medicine courses for the construction of integrative knowledge of the animal body. Since the masterful purpose of Anatomy is the investigation of form (from architecture to structure) and function, also going through the process of embryonic development of the animal body, dissection cannot be abandoned in Higher Education.

Virtual teaching for medical students has enabled medical education to continue despite the effects of the pandemic. The COVID-19 outbreak has provided medical education faculties with the perfect opportunity to develop and further the application and effectiveness of virtual learning for medical students. Medical education faculties should embrace the transition to virtual teaching and continue to develop web-based materials, such as secure web-based assessments and resources with increased student interactivity, to ensure that the most effective and suitable teaching is delivered.

Finally, because it is undeniable that the development of teaching methods capable of providing replacement, reduction, and refinement to the use of animals as didactic models is today a great challenge, future research must be developed to assess how much distance education can really bring benefits to students' academic performance.

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## ETHICAL APPROVAL

The research was carried out at the University of São Paulo (USP), registered and approved by the Ethics Committee on the Use of Animals (CEUA), an Advisory Committee of the Faculty of Veterinary Medicine and Animal Sciences (FMVZ), under the protocols n. 7319120319 (Plataforma de ensino em anatomia animal: conteúdos didáticos para o ambiente virtual de aprendizagem e impressão 3D como técnica anatômica), n. 8147071019 (Elaboração de uma ferramenta interativa destinada ao estudo do Sistema Nervoso Central em ovinos), n. 5231130916 (Elaboração de uma ferramenta de ensino-aprendizagem multidisciplinar de neuroanatomia do equino (*Equus caballus*, Linnaeus 1758), n. 9493070218 (Caracterização e descrição do Sistema Nervoso Central do Macaco-prego (*Cebus apella*) para o estudo e ensino da neuroanatomia veterinária e comparada), n. 9121270420 (Desenvolvimento de uma plataforma de ensino a distância da anatomia cirúrgica do equino como ferramenta complementar na formação em cirurgia veterinária), n. 9411060918 (Atlas digital interativo multidisciplinar de neuroanatomia funcional de bovinos (*Bos taurus*, Linnaeus 1758), n. 6988100818 (Plataforma digital: método complementar de ensino-aprendizagem da embriologia comparativa), n. 8791190216 (Atlas digital interativo multidisciplinar de neurologia funcional do gato (*Felis catus*, Linnaeus, 1758).

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**RESUMEN:** Se han efectuado importantes cambios curriculares desde el primer curso de Medicina Veterinaria de Brasil en 1910. El proyecto pedagógico se ha centrado en el alumno como sujeto de aprendizaje con apoyo de los docentes como mediadores críticos de este proceso; con la pandemia de COVID-19 se aceleró este cambio. Muchos profesores han impartido lecciones en video para garantizar la continuidad de la docencia, la investigación y la extensión, incluso a distancia. Este artículo tiene como objetivo informar sobre el desarrollo de los contenidos didácticos sobre la anatomía animal, aplicados en plataformas online en portugués. Para ello, se desarrollaron ocho investigaciones que abordan la enseñanza-aprendizaje de contenidos de Ciencias Morfológicas para ser incorporados en plataformas de educación a distancia que enfocaran la anatomía canina y felina, el estudio de la neuroanatomía en las especies ovina, bovina, equina y primate, y la anatomía quirúrgica del aparato locomotor de la es-

pecie equina. De esta forma, la plataforma virtual de enseñanza-aprendizaje puede complementar las clases presenciales en la obtención de las habilidades y actitudes requeridas para la formación de los estudiantes de veterinaria en Brasil.

**PALABRAS CLAVE: Educación veterinaria; Educación a distancia; Plataformas online.**

## REFERENCES

- Alsharif, M. H. K.; Gasmalla, H. E. E.; Elamin, A. Y.; Almasaad, J. M. & Elhag, A.E. In Light of COVID-19 Crisis: Proposed Guidelines for the "New Norm" of Anatomy Teaching. *Medical Sci.*, 24(105):3281-90, 2020.
- Bernkopf, M.; Franz, S. & Baumgartner, W. Experiences with a Blended Learning Course for Clinical Veterinary Education at the University of Veterinary Medicine Vienna, Austria. *Tierärztliche Praxis Großtiere*, 38:99-108, 2010.
- Brasil. Lei nº 14.023, de 8 de julho de 2020. *Altera a Lei nº 13.979, de 6 de fevereiro de 2020, para determinar a adoção de medidas imediatas que preservem a saúde e a vida de todos os profissionais considerados essenciais ao controle de doenças e à manutenção da ordem pública, durante a emergência de saúde pública decorrente do coronavírus responsável pelo surto de 2019*. Brasília, Diário Oficial da União, 2020. Ed. 130, Seção 1, pp. 1. 2020.
- Brassett, C.; Cosker, T.; Davies, D. C.; Dockery, P.; Gillingwater, T. H.; Lee, T. C.; Milz, S.; Parson, S. H.; Quondamatteo, F. & Wilkinson, T. COVID-19 and anatomy: Stimulus and initial response. *J. Anat.*, 237(3):393-403, 2020.
- Capdeville, G. O Ensino Superior Agrícola no Brasil. *RBEP*, 72(172), 1991.
- Ferreira, J. M. M. *Flipped classrooms: From concept to reality using Google Apps*. International Conference on Remote Engineering and Virtual Instrumentation, 204-8, 2014.
- Fleagle, T. R.; Borcherding, N. C.; Harris, J. & Hoffmann, D. S. Application of flipped classroom pedagogy to the human gross anatomy laboratory: Student preferences and learning outcomes. *Anat. Sci. Educ.*, 11(4):385-96, 2018.
- Heymann, D. L. & Shindo, N. COVID-19: what is next for public health? *Lancet*, 395(10224):542-5, 2020.
- Johnson, I. P.; Palmer, E.; Burton, J. & Brockhouse, M. Online learning resources in anatomy: What do students think? *Clin. Anat.*, 26(5):556-63, 2013.
- Kerr, A. J.; Mullan, S. M. & Main, D. C. A new educational resource to improve veterinary students' animal welfare learning experience. *J. Vet. Med. Educ.*, 40(4):342-8, 2013.
- Kolb, D. A. *Experiential Learning: Experience as the Source of Learning and Development*. FT Press, 2014.
- Mahdy, M. A. A. The impact of COVID-19 pandemic on the academic performance of veterinary medical students. *Front. Vet. Sci.*, 7:594261, 2020.
- Matthew, S. M.; Schoenfeld-Tacher, R. M.; Danielson, J. A., & Warman, S. M. Flipped classroom use in veterinary education: a multinational survey of faculty experiences. *J. Vet. Med. Educ.*, 46(1):97-107, 2019.
- Plendl, J.; Bahramsoltani, M.; Gemeinhardt, O.; Hünigen, H.; Kässmeyer, S. & Janczyk, P. Active participation instead of passive behaviour opens up new vistas in education of veterinary anatomy and histology. *Anat. Histol. Embryol.*, 38(5):355-60, 2009.
- Rodriguez-Morales, A. J.; Gallego, V.; Escalera-Antezana, J. P.; Méndez, C. A.; Zambrano, L. I.; Franco-Paredes, C.; Suárez, J. A.; Rodríguez-Enciso, H. D.; Balbin-Ramon, G. J.; Savio-Larriera, E.; et al. COVID-19 in Latin America: The implications of the first confirmed case in Brazil. *Travel Med. Infect. Dis.*, 35:101613, 2020.
- Ryan, M. T.; Baird, A. W.; Mulholland, C. W. & Irwin, J. A. Practical classes: A platform for deep learning? Overall context in the first-year veterinary curriculum. *J. Vet. Med. Educ.*, 36(2):180-5, 2009.
- Sandrone, S.; Berthaud, J. V.; Carlson, C.; Cios, J.; Dixit, N.; Farheen, A.; Kraker, J.; Owens, J. W. M.; Patino, G.; Sarva, H.; et al. Strategic considerations for applying the flipped classroom to neurology education. *Ann. Neurol.*, 87(1):4-9, 2020.
- Taha, M. H.; Abdalla, M. E.; Wadi, M. & Khalafalla, H. *Curriculum delivery in Medical Education during an emergency: A guide based on the responses to the COVID-19 pandemic*. MedEdPublish, 9, 2020.
- Wilcha, R. J. Effectiveness of virtual medical teaching during the COVID-19 crisis: systematic review. *JMIR Med. Educ.*, 6(2):e20963, 2020.
- Zhou, L.; Wu, S.; Zhou, M. & Li, F. 'School's Out, But Class' On', The Largest Online Education in the World Today: Taking China's Practical Exploration During The COVID-19 Epidemic Prevention and Control As an Example. *Best Evid. Chin. Edu.*, 4(2):501-519, 2020.

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