Ciência Rural, Santa Maria, v.55:1, e20240214, 2025
http://doi.org/10.1590/0103-8478cr20240214
ISSNe 1678-4596
CLINIC AND SURGERY

Preliminary study on online and in-person teaching methods for animal anatomy

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ABSTRACT: Anatomy teaching has been changing over the years, introducing technological methods especially after the pandemic period. An ongoing debate revolves around whether exclusive reliance on technology for anatomy classes, as opposed to traditional methods and face-to-face instruction, enhances knowledge acquisition. This study analyzed the knowledge perception of students from various semesters throughout the Veterinary Medicine course, comparing students who only had online classes with those who had face-to-face classes in Gross Anatomy of Domestic Animals. For this purpose, a questionnaire was distributed for voluntary and anonymous completion, and the responses were subsequently analyzed statistically. The results indicated that 11.5% of the students who took Anatomy remotely failed to apply the knowledge in other subjects, while no face-to-face learning student reported the same. Most students, both remote and face-to-face groups, remember the subject but review the content frequently. Regarding theoretical knowledge, the online group (80.8%) understood better as the course progressed, compared to 59.6% of the face-to-face group. The connection between Anatomy and other subjects was more highlighted by the face-to-face group (30.8%) compared to the online group (15.4%). Both groups agree that physical contact with anatomical specimens is essential; however, some believe that initial exposure through 3D images or photographs is feasible. We concluded based on this preliminary study that the initial interactions with the Anatomy field should include diversified pedagogical techniques with empathetic communication. The use of modern technological resources are allies in the teaching-learning process. Furthermore, after abstracting the contents, technology alone can effectively maintain and update anatomical knowledge.
Key words: face-to-face instruction, methodology, morphology, online instruction, anatomy.

Estudo preliminar sobre os métodos de ensino online e presencial em anatomia animal

RESUMO: O ensino de anatomia vem se modificando ao longo dos anos, introduzindo métodos tecnológicos, principalmente após o período pandêmico. Questiona-se o uso exclusivo da tecnologia em comparação aos métodos tradicionais de dissecação e aulas teóricas presenciais no que diz respeito à aquisição de conhecimento. Este artigo analisou a percepção de conhecimento de alunos de diversos semestres do curso de Medicina Veterinária, comparando alunos que tiveram aulas apenas online com aqueles que tiveram aulas presenciais de Anatomia Descritiva dos Animais Domésticos. Para tanto, questões foram enviadas por meio de formulário, com preenchimento voluntário e anônimo, e posteriormente analisadas estatisticamente. Os resultados indicam que 11,5% dos alunos que cursaram a disciplina remotamente falharam na aplicação dos conhecimentos em outras disciplinas, enquanto nenhum aluno do ensino presencial relatou o mesmo. A maioria dos alunos, tanto dos grupos remotos quanto dos presenciais, lembram-se do assunto, mas revisam o conteúdo com frequência. Em relação ao conhecimento teórico, o grupo online (80,8%) compreendeu melhor à medida que o curso avançava, comparado a 59,6% do grupo presencial. A ligação entre Anatomia e outras disciplinas foi mais destacada pelo grupo presencial (30,8%) em comparação ao online (15,4%). Ambos os grupos concordam que o contacto físico com peças anatômicas é essencial, mas alguns consideram possível ter um primeiro contacto com imagens ou fotografias 3D. Baseado nesse estudo preliminar, conclui-se que as interações iniciais com a área de Anatomia devem incluir técnicas pedagógicas diversificadas com comunicação empática. A utilização de recursos tecnológicos modernos é um aliado do processo de ensino-aprendizagem, e após a abstração dos conteúdos é possível o uso singular da tecnologia na manutenção e atualização do conhecimento anatômico.
Palavras-chave: ensino presencial, metodologia, morfologia, ensino online.

INTRODUCTION

The importance of anatomy in medical education, including Veterinary Medicine, is unquestionable. Until a few years ago, dissection and traditional theoretical classes were the sole teaching methods. Since then, especially during the COVID-19 pandemic, teaching methodologies have been revolutionized with greater use of the internet, applications, images, and simulations to further consolidate and enhance the learning experience (SUGAND et al., 2010; TRELEASE, 2016; IWANAGA et al., 2021).

Received 04.13.24 Approved 05.28.24 Returned by the author 07.18.24
CR-2024-0214.R1
Editor: Rudi Weiblen

Conversely, SUGAND et al. warned back in 2010 that limitations in anatomy teaching could lead to significant issues, such as reduced dissection time and a smaller number of qualified anatomy instructors, ultimately compromising the quality of education. The authors further emphasized that this decline in anatomical education would inevitably lead to incompetent anatomists and healthcare professionals, potentially having severe consequences for patients, which can easily be extended to the field of Veterinary Medicine.

MASSARI et al. (2018) mentioned the importance of teaching Anatomy across all health fields. They concluded that the most effective teaching methodology for Veterinary Anatomy is the one that combines hands-on practice (dissection) with all modern technological resources.

With this purpose in mind, the perception of Gross Anatomy knowledge among students from various semesters of the Veterinary Medicine course at the Federal University of Agreste of Pernambuco, Brazil (UFAPE) was investigated by comparing online classes that were held during the social distance period of the pandemic with face-to-face classes (both before and after the pandemic).

MATERIALS AND METHODS

A questionnaire was distributed among students from the second to the tenth semester of the Veterinary Medicine program at the Universidade Federal do Agreste de Pernambuco (UFAPE), as quantitative research. The questionnaire included questions about their perception of learning in the Gross Anatomy of Domestic Animals course, which is offered in the first semester of the program and has a workload of 120 hours. Seventy-seven students (26%) responded to the questionnaire voluntarily and anonymously.

Out of the 77 students who responded to the questionnaire, 26 took the Gross Anatomy of Domestic Animals course entirely online during the COVID-19 pandemic isolation period, while 51 students took it in-person. The fact that these students took the Gross Anatomy course online does not necessarily mean that they took other courses remotely, as the most severe isolation period during the pandemic was between 2020 and 2021. The students who took Gross Anatomy remotely (26) answered the questions while they were in the sixth and seventh semester of the Veterinary Medicine undergraduate program. The remaining students (51) were distributed from the second to the fifth and from the eighth to the tenth semester of the course.

For online Descriptive Anatomy of Domestic Animals lectures, Google Meet platform was used for remote synchronous classes, while the Google Classroom platform was used to post texts (books, articles, handouts), videos and assessment activities. Weekly, the lecturer presented the subject and listened to students regarding expectations and questions. Following the lecture, an activity on the respective subject was discussed and the students were assessed. Practical demonstrations on the same subject were conducted using resources (photographs, online videos, University websites, including the Animal Anatomy and Pathology Laboratory-LAPA at UFAPE, all of which were free). Additionally, the lecturer utilized 3D Animal Anatomy softwares from various domestic species, such as Biosphera® (Equine Anatomy, Cow Anatomy, Pig Anatomy, Bird Anatomy), and showed dissected structures from LAPA.

The face-to-face classes were taught through exposition and discussion of the subject by the lecturer, using a projector or television, and computer. Afterward, an assessment was discussed and conducted. The practices were hands-on, using prosections of natural organs and animals previously prepared with formalin (fixation), preserved in saturated saline solution (OLIVEIRA, 2014) and dissected. During these practical sessions, the lecturer was assisted by one or two teaching assistants to support the students. The respondents were informed and clarified about the study's objectives through the Informed Consent Form (ICF), which was prepared in accordance with Resolution 466/2012-CNS/MS and Circular Letter 02/2021/CONEP/SECNS/MS, directly within the questionnaire. However, they did not sign it since the questionnaire did not collect personal information such as name, email addresses, or documents.

The data were analyzed descriptively through the relative frequency of the responses obtained in the questionnaire. The data were removed from the "cloud" after the data collection ended and will be archived for five years on the personal computer of the responsible researcher. After this period, they will be permanently deleted.

RESULTS

When asked about their success in applying the knowledge acquired in Anatomy to other subjects such as Veterinary Physiology, Semiology, Medical Clinic, and Surgery, 11.5% of the students who took Anatomy remotely responded that they have not been successful, whereas this was not reported by

any of the in-person (face-to-face) group (0%). Only 7.7% of the remote class students still remember most of the subject matter, compared to 25% of the in-person class students. The vast majority in both groups (80.8% remote, 75% in-person) reported still remembering the subject matter, although they need to review the content frequently (Table 1).

Regarding theoretical knowledge of the subject, 80.8% of students who took the course online reported that they better understood the anatomy content as the course progressed, in contrast to 59.6% of those who took the course in person (Table 1). Both online (15.4%) and in-person (38.5%) students reported having a good memory of the theoretical content but reviewing it whenever necessary. However, 3.8% of the survey participants who studied Anatomy online did not see any connection with other subjects in the program, similar to 1.9% of

Table 1 - Questions applied to the groups of undergraduate students of the Veterinary Medicine course at UFAPE regarding the perception of knowledge in Gross Anatomy of Domestic Animals during face-to-face classes and online classes.

Questions	Face-to-face (%)	Online (%)
---------Have you successfully used the knowledge acquired in the Gross Animal Anatomy course in other subjects of the program?--------		
Yes, I still remember most of it.	25.0	7.7
Yes, but I must review it often.	75.0	80.8
No	0.0	11.5
----------Regarding the theoretical knowledge of the Gross Animal Anatomy course----------		
I remember it well, but, when necessary, I review it.	38.5	15.4
With the progression of the course, I have come to understand the anatomy content better.	59.6	80.8
I do not see a connection with other subjects in the course, so I forget more and more as time passes.	1.9	3.8
----------Regarding the practical knowledge of the Gross Animal Anatomy course----------		
I still remember most of those names	30.8	15.4
I only remember the names which were still used in other courses of the program.	57.7	69.2
As each term passes, I remember fewer and fewer names.	11.5	15.4
----------Still concerning the practical knowledge of the Gross Animal Anatomy course----------		
When hearing or reading the official name of an anatomical structure, I can locate it correctly.	75.0	65.4
I cannot associate the name and location of anatomical structures without assistance.	19.2	34.6
I can remember the official name of the structure and locate it.	5.8	0.0
----------Have you completed internships in any area of Veterinary Medicine?----------		
Yes, and I needed knowledge of Gross Anatomy.	73.1	84.6
Yes, but I did not need knowledge of Gross Anatomy.	5.8	15.4
No	21.2	0.0
--If you have any doubts and need to review any content from the Gross Anatomy of Domestic Animals course, where would you start?--		
Search engines (e.g., Google).	13.5	15.4
Notes	21.1	26.9
Books	42.3	42.3
Google Classroom of the course	23.1	15.4
--In the absence of physical contact with anatomical specimens, to learn the practical content of Gross Anatomy for the first time, you think that--		
It is not possible to learn practical anatomy without physical contact with anatomical specimens.	67.3	53.8
3D models (tridimensional) of the specimens, with the labeling of the features, would be sufficient.	25.0	38.5
Photographs of the specimens, with labeling of the features, would be sufficient.	7.7	7.7
To review the practical content of Gross Anatomy at any time during the course or professional life, after having already had physical ----------contact with the specimens through a class on each topic, you think that----------		
It is not possible to review practical anatomy without physical contact with anatomical specimens.	17.3	11.5
3D models (tridimensional) of the specimens, with the labeling of the features, would be sufficient.	50.0	61.5
Photographs of the specimens, with labeling of the features, would be sufficient.	32.7	26.9

the in-person students, leading to a gradual forgetting of the acquired theoretical knowledge.

More than half of the research participants (69.2% online and 57.7% in-person, Table 1) reported that they only remembered the anatomical nomenclature if it continued to be used in other disciplines, depending on the area and structures studied. In-person students had a higher rate (30.8%) of still remembering the nomenclature of most structures studied in the practical classes of Gross Anatomy, compared to online students (15.4%). Conversely, 15.4% of online students and 11.5% of in-person students remembered fewer official names of the structures studied.

Regarding practical knowledge of Anatomy, students from both groups (online 65.4%, in-person 57.7%) reported that when hearing or reading the official name of an anatomical structure, they could locate it correctly. However, only students who had in-person classes mentioned being able to remember the official name and locate the structure, albeit at a reduced frequency (5.8%). More students who had online classes (34.6%) reported being unable to associate the name and location of the structures without help compared to those who had in-person classes (19.2%), as shown in table 1

All students who took Anatomy classes online completed internships, with 84.6% needing knowledge of Gross Anatomy during their internship period. Among the in-person students, 21.2% had not yet completed their internships, 5.8% had completed internships but did not require knowledge of Gross Anatomy, and 73.1% needed anatomical knowledge during their internships (Table 1).

The methods of reviewing the content of the Gross Anatomy of Domestic Animals course were similar in both groups (Table 1). Most students used books to review (online and in-person 42.3%), but they also relied on notes (26.9% online, 21.1% in-person), the Google Classroom for the course (15.4% online, 23.1% in-person), and search engines (15.4% online and 13.5% in-person).

The majority of students in both groups expressed the opinion that it is not possible to learn practical anatomy without physical contact with anatomical specimens (53.8% online, 67.3% in-person). However, 38.5% of the online students and 25% of the in-person students believed that an initial exposure to Anatomy through 3D images or photographs is feasible. In fact, only 7.7% of the students in both groups shared this view.

After having had contact with anatomical specimens at least once in each topic of the Gross Anatomy of Domestic Animals course, the majority agreed that it is possible to review the discipline content through 3D images (61.5% online and 50% in-person) followed by photographs (26.9% online and 32.7% in-person). Although, 11.5% of the students who had remote classes and 17.3% of the students with in-person classes mentioned that it is not possible to review Gross Anatomy without physical contact with anatomical specimens (Table 1).

DISCUSSION

The classic practice lectures in Animal Anatomy in the Veterinary Medicine program are similar to those applied to Human Anatomy: cadavers, or parts of them, preserved or not, are arranged on tables, and the lecturer guides the study of anatomical structures, often associating them to clinical and professional experiences. These cadavers are either dissected by the students or previously prepared and dissected (prosection) for the study of anatomical particularities. At the Federal University of Agreste de Pernambuco, Gross Anatomy of Domestic Animals is taught using prosection, except during the period of isolation due to the COVID-19 pandemic. According to SILVA NETO (2007), dissection promotes the development of specific skills, creates proficiency in handling surgical instruments, and combines the training of psychosocial skills, making learning more effective, more active for the student bringing closer the lecturer-student binomial, allowing greater exchange of experiences and better construction of anatomical knowledge. However, TOPP (2004), despite recognizing the benefits of practicing dissection, suggests that learning is not dependent on performing dissections, but rather on excellent instruction, interaction with peers, continuous self-assessment, and dissemination and testing of newly acquired knowledge.

The exclusive use of technologies in teaching Animal Anatomy has some advantages. For instance, it avoids exposure to potentially toxic fixative solutions such as formaldehyde; it also eliminates any contamination risk, and facilitates access to study by reducing the need to be in a laboratory;. Furthermore, it also reduces the cost of anatomical techniques (PONTINHA & SOEIRO, 2014). However, during the social isolation imposed by the COVID-19 pandemic, we observed the limitations of this method, particularly for students who had not had any classical anatomical experience.

The COVID-19 pandemic caught most institutions and students by surprise and unprepared

for the technological challenges imposed by isolation. Consequently, everyone had to adapt and incorporate technological advances at an unprecedented speed (FRANCHI, 2020; IWANAGA et al., 2021; ONIGBINDE et al., 2021). However, not everyone (students and lecturers) managed to adapt to this new reality as quickly as needed. Thus, whether due to difficulties in dealing with technology, internet connection quality, equipment quality (PINTO, 2021), or lack of spatial skills training (FERNANDEZ et al., 2011), 11.5% of students who had remote classes reported not being successful in applying Anatomy knowledge to other subjects, and only 7.7% still remembered the material well, contrasting with 25% who had in-person classes.

Spatial ability (whether computational or physical) has been studied as a key requirement for successful anatomy learning (FERNANDEZ et al., 2011). Studies suggested that certain spatial cognitive skills are especially important, and characteristic of the work required in clinical anatomy, and that education and experience contribute to further development of these skills. This data may explain the poor application of knowledge by students who took online classes, as they did not have the opportunity to manipulate real or virtual anatomical specimens (3D images) during their classes, and thus missed out on developing or enhancing spatial skills.

The lack of face-to-face experience in the discipline limits discussions on the application of knowledge in other areas and hinders reinforcement of learning. This may explain why a high percentage of online students (80.8%), compared to in-person students (59.6%), come to better understand the theoretical content of anatomy only as the course progresses or continue to not understand the connection with other subjects (3.8% online and 1.9% in-person). Supporting this assertion, the retrieval and review of topics are viewed with restrictions by online students, with less than half (15.4%) of occurrences compared to in-person students (38.5%). This suggests they may not know or feel confident about the resources and references to resume studying the discipline. This same trend was observed regarding the practical content of the discipline. These findings align with those of PIZZIMENTI & AXELSON (2015), who reported that the level of student involvement with the discipline is related to the strategies, barriers students face, and whether the course materials and activities are producing good learning outcomes. The greater use of learning strategies such as elaboration and critical thinking is associated with higher course performance levels, as are motivation sub-scales for learning (PIZZIMENTI & AXELSON, 2015). Similarly, KUSURKAR et al. (2011) reinforce that the learning environment plays an important role in increasing motivation.

Only the in-person students reported success in remembering the official names of structures and locating them correctly. In contrast, 34.6% of online students could not associate the name with the correct structure without assistance, which reinforces the importance of hand-on experience with specimens along with dedicated discussions, for learning and building student's confidence. The lack of retention of Anatomy knowledge was also observed by DOOMERNIK et al. (2017), when they evaluated second-year medical students and found that theoretical knowledge decreased by approximately 15% a year and a half after the initial anatomy course. The authors also added that this loss of knowledge is relatively small compared to previous studies.

Opportunities and participation in internships during undergraduate studies increase with each semester, which corroborates to the fact that remote classes of Gross Anatomy of Domestic Animals, in the sixth and seventh semesters of the Veterinary Medicine program, had 100% of the students with internship experience. The lack of face-to-face classes may have led to a higher demand (15.4%) for internships that did not require knowledge of Anatomy, compared to in-person classes (5.8%).

The review methods for in-person and online classes were similar, indicating that the type of class does not determine the type of material to be reviewed. One might expect online classes to review more on digital resources and in-person classes using physical means for reviewing. However, with the availability of free digital books and other storage methods (such as Google Classroom and Drive), along with internet searches, coupled with the fact that this generation is digital, the research supported this historical reality.

Very similar data were also reported between the groups of online and in-person students regarding the initial learning and subsequent reviews of practical anatomy. Students, regardless of the type of class received, understand that physical contact with anatomical specimens is necessary in the initial interactions with anatomy.

After learning the content of Gross Anatomy, most of the students agreed that technological imaging resources (2D or 3D) are

effective for reviewing or updating, with 3D figures being the preferred option according to research participants in both groups. Indeed, PETERSON & MLYNARCZYK (2016) report that the addition of 3D learning tools can positively influence the long-term retention of macroscopic anatomy material and should be considered as a beneficial supplement to anatomy courses.

The diversity of pedagogical methods favors inclusion and benefits all students in the teaching-learning process. Multimodal anatomy teaching has also been widely recognized and evaluated, as reported by SUGAND et al. 2010. The challenges lie in reinstating more effective teaching and learning tools while maintaining the beneficial values of traditional dissection. Therefore, the use of technology does not exclude the need for proximity between teachers, students, and practical materials, as well as discussions and face-to-face contact among those involved.

CONCLUSION

Initial interactions with the field of Anatomy should include physical proximity (among lecturers, students, and anatomical specimens), empathetic communication, and immersion in each subject, utilizing diversified pedagogical techniques. At this stage, the use of modern technological resources should be an ally in the teaching-learning process, together with physical contact, rather than replace it. Once the foundational content has been assimilated it is possible to use technology singularly to maintain and update the anatomical knowledge.

BIOETHICS AND BIOSECURITY COMMITTEE APPROVAL

This research was approved by the Research Ethics Committee (CEP/CONEP) under protocol number 75904123.5.0000.0128.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors contributed equally to the conception and writing of the manuscript. All authors critically reviewed the manuscript and approved the final version.

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