



3D MODELS AND SKETCHFAB PLATFORM AS A NEW TOOL IN VETERINARY ANATOMY EDUCATION

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Abstract: Today there is a rising trend in the use of 3D models and different digital technologies in veterinary medicine education and research. In the last couple of years, our department created 3D neuroanatomical models by using the XYZ-3D scanner. These models are now available to our students and the public through the open-source Sketchfab platform. We use these models in practical anatomy classes and for the online self-learning process. The main aim of this study was to evaluate how students accept, and how are they satisfied with the use of these models and the Sketchfab platform in veterinary anatomy education. For this study purpose, at the end of the academic 2023/24, we created an anonymous questionnaire for students in Likert style, and the survey was performed through the Google Forms platform. The results of the survey show that 3D digital models are very acceptable to students and they can be used as additional, supportive tools in veterinary anatomy education and for the self-learning process. Also, in the present research, we discuss the advantages, disadvantages, and future potential and benefits that 3D technologies and this platform can provide. By sharing this information with the academic community, we believe that this study will certainly contribute to the improvement and expansion of the use of 3D digital models as alternative tools in veterinary medicine education and research.

Keywords: 3D models, Sketchfab, veterinary medicine, education, anatomy.

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Introduction

Traditional tools used in neuroanatomy classes are lectures, courses, 2D anatomic atlases, and cadaveric dissection combined with colored plastic and even clay models (Adrian et al., 2024, Aydin et al. 2023, Van Deursen et al. 2021, Sugand et al. 2010). Recently, there has been a rising trend in the use of 3D models and different digital technologies in veterinary medicine education and research. The research confirms that the use of these technologies in education improves the quality of teaching and the learning outcomes of students (Murgitroyd et al. 2015, Chen et al. 2020, Kurul et al. 2020, Zhao et al. 2020, Erolin, 2019, Azer and Azer 2016, Fredieu 2015, Estai and Bunt 2016, Kong 2016, Kurul, et al. 2020, Moro et al. 2017, Ekstrand et al. 2018, Narang et al. 2021, Shui et al. 2017). The use of digital technology has especially increased during the pandemic outbreak of coronavirus disease (COVID-19). The pandemic outbreak has created the largest disruption of education systems in human history (Iwanaga et al. 2021). In April 2020, UNESCO reported that during the lockdown measures, students in 188 countries had no access to the classrooms. Most of the classes, from primary to tertiary level were organized through the online system (Byrnes et al. 2021). In this period various digital, and online technologies have become the

only way of communication between teachers and students. Transitioning from a traditional to an online learning system has challenged all anatomy teachers. To continue classes and provide high-quality education, assessments, and even research anatomical teachers worldwide have used different tools such as social media (Facebook, Twitter, YouTube), online platforms for meetings (Zoom, Teams, GoToMeeting, etc.), digital data and images from Computerized Tomography (CT) and Magnetic Resonance Imaging (MRI), 3D augment, and virtual reality, etc. (Byrnes et al 2020). In the digital world, the Sketchfab platform is considered one of the leading platforms for 3D models (Erolin 2019). The platform was launched in 2012 and today it has more than 6 million users and over 15 million 3D models (<https://sketchfab.com/about>). Through this platform, the users can observe, download, upload, buy, or sell 3D models and even create tasks for students that can help them learn and understand different lectures (Scopigno et al. 2017). Although this is the leading platform for 3D models, and some veterinary faculties already have 3D anatomy models on it, there is very little written data about its use in veterinary medical education. This research aimed to evaluate how students accept, and how are they satisfied with the

use of 3D models and the Sketchfab platform in veterinary anatomy education.

Materials and Methods

To create 3D models as material we used one formalized bovine brain, three sheep brains, one 3D-printed plastic model of the horse brain, and the spinal cord. The samples were scanned by XYZ hand scanner and saved as 3D digital objects in obj. or stl. format, in natural color and size. Scanned samples were downloaded on the Sketchfab platform. With the free available tools on this platform, we labeled all important anatomical structures with Latin names, following the *Nomina Anatomica Veterinaria* (ICVGAN 2017). The Sketchfab platform and downloaded 3D models were presented to our students of the first year during the practical anatomy classes where we gave the students detailed instructions

on how to use them. To evaluate students' acceptance, and how are they satisfied with the use of these models and the Sketchfab platform in veterinary anatomy education, at the end of the summer semester, academic 2023/24 year, we created an anonymous, voluntary-based questionnaire in Likert style. The survey was conducted online by using Google Forms Questionnaire (<https://www.google.com/forms/about/>). The questionnaire form of the survey is presented in Table 1. All 40 students of the first-year study voluntarily participated in this study. Descriptive statistical data of the survey were presented in chart form. At the end of the semester, we also interviewed the teachers (two professors and one assistant), and asked them to give their opinions about the main advantages and disadvantages of the use of 3D models and the Sketchfab platform.

Table 1. The questionnaire form of the survey provided by Google Form

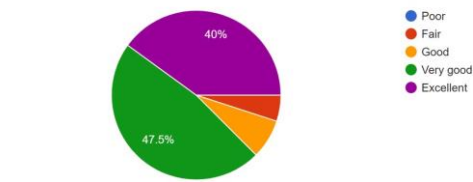
Questions	Answer-Option-1	Answer-Option-2	Answer-Option-3	Answer-Option-4	Answer-Option-5
1. Rate the clarity and visibility of the 3D models of the nervous system placed on the Sketchfab platform	Poor	Fair	Good	Very good	Excellent
2. How satisfied are you with the quality of the 3D model of the nervous system on the Sketchfab platform?	Poor	Fair	Good	Very good	Excellent
3. Rate how satisfied you are with using the Sketchfab platform	Poor	Fair	Good	Very good	Excellent
4. Rate the quality of manual manipulation of 3D models on the Sketchfab platform	Poor	Fair	Good	Very good	Excellent
5. Rate how satisfied you are with the position of the Latin names of the anatomical structures	Poor	Fair	Good	Very good	Excellent
6. On Sketchfab you can find 3D models of formalized and 3D printed models. Which are better and clearer for you:	- Fromlized - 3D printed				
7. Do you think that 3D models can completely replace real organs in practical classes of veterinary neuroanatomy?	Yes	No	Maybe	Your opinion	

Results and Discussion

All 3D neuroanatomical models were successfully presented in natural shape, size, and color through the Sketchfab platform (Figure 1.). The models were available to students by phones, tablets, laptops, and computers 24 hours a day (<https://sketchfab.com/realanatomy>). The survey shows that students were very satisfied with the visibility, clarity, and quality of the 3D models (Graphs 1 and 2). Also, they were very satisfied with the use of this platform, model manipulation, and position of anatomical labels (Graphs 3, 4, and 5). However, the scanned 3D plastic models were rated as the clearest and more acceptable for students compared to formalized ones (Graph 6). This result is

probably related to the fact that the plastic models were normally much larger than the formalized specimens and important anatomical structures on them were painted in different colors to facilitate the identification of different anatomical structures. On the other side, the 3D models obtained by scanning the formalized specimens are naturally smaller, more complex, and without any additional coloring which requires a certain concentration in recognizing the right anatomical structures. The research reveals that 30 % of the students have the opinion that 3D digital models can completely replace formalized neuroanatomical specimens in-class learning, while 20 % of them think they can't, and 40% of the students are not sure (Graph 7).

1. Rate the clarity and visibility of the 3D models of the nervous system placed on the Sketchfab platform
40 responses



Graph 1. Students' assessment of clarity and visibility of 3D models

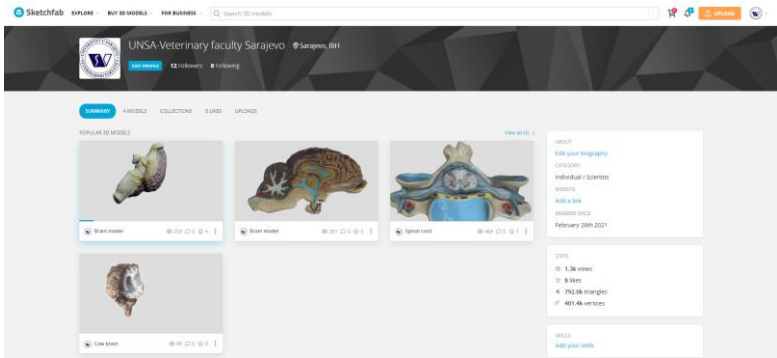
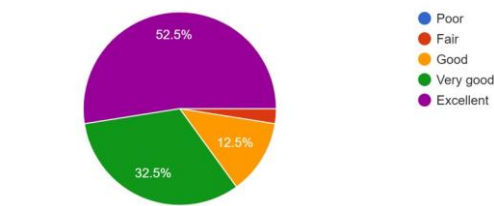


Figure 1. 3D neuroanatomical models presented by SketchFab platform

2. How satisfied are you with the quality of the 3D model of the nervous system on the Sketchfab platform?
40 responses

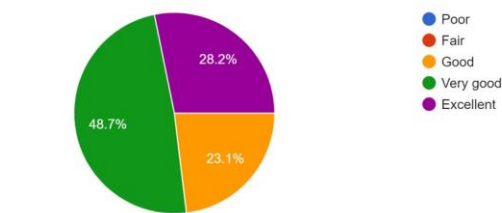


Graph 2. Students' assessment of the quality of 3D models

Interestingly, some students stated that perhaps not neuroanatomical specimens, but animal bones and muscles could be completely replaced by 3D interactive models. The teachers agree that these models are useful in the recognition and understanding of the position, shape, size, and relationship of different anatomical structures and they should remain permanently available online to students. According to the

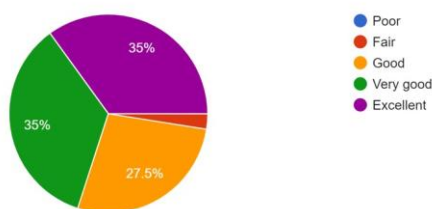
teacher's opinion, the main advantage of the 3D models and Sketchfab platform is that the models are easily accessible to students, while the main disadvantage is the limited number of labels that can be placed onto the one 3D model for free. The Sketchfab platform offers only 10 labels per model for free. Because of that, some of the models were uploaded two times, so that all required structures could be marked and displayed.

3. Rate how satisfied you are with using the Sketchfab platform
39 responses



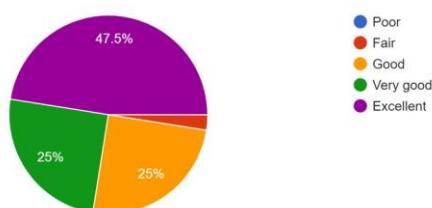
Graph 3. Students' satisfaction and assessment about the use of Sketchfab platform

4. Rate the quality of manual manipulation of 3D models on the Sketchfab platform
40 responses



Graph 4. Students' assessment about the quality of manipulation with 3D models

5. Rate how satisfied you are with the position of the Latin names of the anatomical structures
40 responses

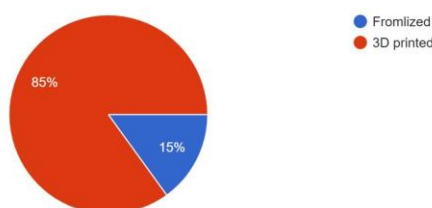


Graph 5. Students' assessment of the position of Latin names

The present study shows that 3D neuroanatomical models and the Sketchfab platform are very acceptable for students in practical anatomy classes and during the self-learning process. Study shows that students prefer more colored 3D models obtained from 3D printed, plastic models of the brain and spinal cord, rather than formalized ones because it is much easier for them to identify different anatomical structures. Regarding the clarity, visibility, and quality of 3D neuroanatomical models, students did not find any disruption or distractions, although the Sketchfab platform simplified the geometry of downloaded models (Scopigno et al. 2017). We agree with Scopigno et al. (2017) that publishing and using the 3D models on the Sketchfab platform is very easy and fast. Also, we agree with Caroline Erolin (2019), that to obtain 3D models of good quality the sample scanning must be done by a gentle, slow movement, under the adjustable ambient light. Transparent, dark, or samples with mirrored and shiny surfaces are not suitable for the scanning. The good side of the Sketchfab platform is that some poor-quality 3D models can be improved by additional settings provided by the platform options such as lightning, contrast adjustment, rendering, postprocessing filters, etc. Besides these, for higher accuracy or artifact repair on 3D models, we agree with Xu et al. 2020, and Rubio et al. 2019 that

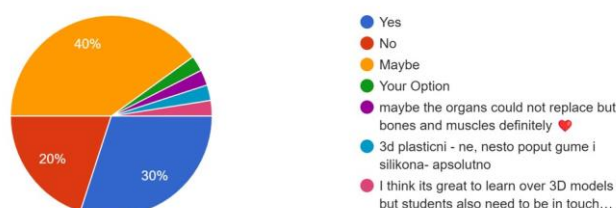
alternatives for scanning are photogrammetry (PGM), and image post-processing in different software such as MeshMixer, AutoDesk, Photoshop, Adobe Systems, etc. On the other side, the Sketchfab platform has a limitation for labeling more than 10 anatomical structures for free per one 3D model. This disadvantage can be solved by uploading the same model two or more times or purchasing a premium package on the platform. However, no matter how good and quality the 3D models are, the study reveals that many students, are not sure or think that 3D interactive models cannot completely replace the classical formalized organs in traditional practical veterinary anatomy classes, but they can be very useful and helpful during in class and the self-learning process. The main advantage for students is that created 3D models are available to them 24 hours through the Sketchfab platform which overcomes the limitations of working hours in traditional anatomy classes. Also, the advantage of this platform and the presentation of 3D models through it is that, unlike AR or VR technologies, special classrooms and equipment are not required (Aridan et al. 2024, Aydin et al. 2023, Jang et al. 2017). Creating 3D models with 3D scanners is technically much easier and simpler. However, it is recommended that scanners can create 3D models in natural color, rather than black and white.

6. On Sketchfab you can find 3D models of formalized and 3D printed models. Which are better and clearer for you:
40 responses



Graph 6. Students' assessment of the comparative quality of 3D printed and formalized models

7. Do you think that 3D models can completely replace real organs in practical classes of veterinary neuroanatomy?
40 responses



Graph 7. Students' opinion on the use of 3D models as an alternative to real organs in neuroanatomy practical classes

Conclusion

3D neuroanatomy models presented by the Sketchfab platform can be used as very good and useful additional, alternative tools in veterinary anatomy education. Students are very satisfied with the use of the Sketchfab platform and 3D models as modern educational technologies and the opportunities they provide. We believe, that these technologies, combined with traditional teaching methods can contribute to a better understanding of neuroanatomical structures, and their shape, size, position, relationships, etc. By sharing this information with the community, we believe that this study will certainly contribute to the improvement and expansion of the use of 3D digital models as alternative tools in veterinary medicine education and research.

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