

Teaching Zoology without Dissection: A study of 3D Virtual Tools for Students

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Abstract

Physical dissection has been practiced in zoological studies for understanding anatomical structures. However, in recent years three-dimensional visual simulation tools have been introduced increasingly in the curriculum. This study aimed to compare Student's understanding of physical dissection and 3D visual simulation tools. A google form survey questionnaire used to collect quantitative data. The questionnaire consisted of multiple-choice questions. A total of 82 participants responded. The responses were analyzed using descriptive methods. The analysis showed that physical dissection was preferred more for developing hands-on skills meanwhile 3D Visual simulations were considered for Sensory comfort and ease of learning. A majority of respondents observed that physical dissection helped in building practical confidence while 3D simulations reduced ethical concerns and discomfort associated with the use of animals in dissection. Many respondents reported that 3D visual simulations were helpful in reducing fear of making mistakes because of its ability to restart and repeat. Most respondents supported the addition of 3D virtual tools in zoological studies. The study suggests that combining physical dissection with 3D visual simulations may enhance learning while addressing comfort related and ethical concerns.

Keywords: Physical dissection, 3D visual simulation, Zoology, Ethical concerns, Student perception.

Introduction

Zoology is a branch of biological science that involves the study of animal structure and function with a strong emphasis on anatomy and physiology. For many years, zoological studies have depended greatly on physical dissection for studying the structural organization of organisms.

Physical dissection has helped students in studying internal and external structures by allowing direct observation of anatomical features, making dissection an effective method of learning (Wood et al., 2025).

However, the use of animal dissection has raised ethical issues over time. In addition to ethical concerns, practical challenges are also present in using animal dissection. Obtaining specimens and purchasing chemical preservatives required in dissection are among the major difficulties. This also creates challenges in waste disposal and environmental impact, increasing the need for sustainable alternatives in anatomy education (Yun et al., 2024).

Apart from these concerns, students and educators may experience discomfort while handling animal specimens. Many students hesitate to handle preserved specimens due to unpleasant odours from chemical preservatives, which may reduce engagement during practical learning. These concerns have encouraged educators to explore alternative teaching methods that maintain learning effectiveness while improving student comfort (Ben Hammouda et al., 2025).

Modern education is rapidly transforming with digital advancements. Technological tools are increasingly being incorporated into biology education to enhance learning experiences. Compared to traditional textbooks and preserved specimens, three-dimensional (3D) simulations provide interactive and non-linear explanations of anatomical structures. Students can rotate, zoom, and repeat procedures, minimizing the fear of making mistakes (Aboregela et al., 2024).

By integrating digital alternatives, educators can address ethical concerns while maintaining pedagogical effectiveness. Virtual tools have been shown to improve visualization and engagement when used alongside traditional laboratory teaching (Elsayed et al., 2025). Therefore, this paper examines whether 3D virtual simulations can serve as a compassionate and effective supplement to physical dissection. Through a survey-based approach, this study analyses student opinions on ethical acceptability and usefulness of digital learning tools.

Literature Review

Digital technologies such as virtual dissection tools, three-dimensional (3D) anatomical models, and simulation-based learning have significantly transformed anatomy education in recent years. These approaches aim to complement or partially replace traditional cadaver-based teaching methods while improving visualization, accessibility, and student engagement.

Virtual dissection and simulation technologies have gained attention as effective alternatives to

conventional anatomy instruction. Virtual dissection applications have been shown to improve conceptual understanding and accessibility for students studying anatomy (Aboregela et al., 2024). Similarly, virtual dissection tables and skill laboratories enhance visualization and provide interactive learning experiences that help students understand anatomical relationships more clearly (Bokil et al., 2024).

Systematic evidence also supports the effectiveness of virtual technology in anatomy education. A systematic review by Elsayed et al. (2025) concluded that virtual anatomy tools improve student engagement, spatial understanding, and learning outcomes when used alongside traditional teaching methods. Virtual reality-based simulation training has also been reported to significantly improve student performance and satisfaction in anatomy learning (Ben Hammouda et al., 2025). Three-dimensional anatomical models, including digital and physical formats, have also been widely studied. The use of 3D anatomy applications has been shown to improve students' comprehension of complex anatomical structures in veterinary education (Blázquez-Llorca et al., 2023). Similarly, combining digital and physical anatomical models has been associated with improved learning outcomes compared to using a single method alone (Wood et al., 2025).

Recent studies have explored the use of 3D-printed anatomical models as substitutes or supplements for cadaveric specimens. Gund et al. (2025) reported that 3D-printed patient models and animal cadaveric models were both effective for beginner learners, with 3D models offering advantages in availability and repeatability. Low-fidelity 3D-printed models have also been shown to improve student understanding in veterinary anatomy practical classes (Schirone et al., 2025). Comparisons between traditional cadaver-based learning and modern digital tools continue to be an important area of research. A randomized controlled trial by Yun et al. (2024) found that students using both donor dissection and virtual methods demonstrated high satisfaction and improved comprehension. Similarly, students taught using physical prosections and 3D anatomical models performed comparably in practical examinations (Waldman et al., 2025).

Overall, the literature indicates that virtual dissection technologies, VR simulations, and 3D anatomical models are effective tools for anatomy education. While these technologies cannot completely replace traditional cadaver-based teaching, they serve as valuable supplementary resources that enhance visualization, accessibility, and student engagement. Hybrid teaching

approaches combining traditional and technology-assisted methods may therefore represent the future of anatomy education.

Research Gap

Although physical dissection has long been considered essential in zoological studies, the increasing availability of 3D virtual simulation tools has provided an alternative method for learning anatomical structures. Many studies discuss the educational value of physical dissection, while others focus on the benefits of virtual 3D simulation tools in anatomy education. However, fewer studies combine both methods and examine students' perceptions and preferences toward them, particularly in zoology education. As a result, there remains a gap in understanding how students evaluate the effectiveness, comfort, and learning outcomes associated with physical dissection and 3D virtual tools. This study aims to address this gap by analyzing student responses through a questionnaire-based approach.

Objectives

The present study aims to:

- To understand students' perception of physical dissection in zoology learning.
- To examine students' perception of 3D virtual simulation tools in biological studies.
- To compare students' preferences between physical dissection and 3D virtual simulations.
- To evaluate the role of dissection and virtual tools in developing confidence and practical understanding.
- To explore students' views regarding ethical concerns related to animal dissection.
- To explore students' comfort level and sensory experience during physical dissection.

Methodology

The present study was survey-based and aimed to assess the understanding of students and educators concerning the use of physical dissection and 3D virtual tools in zoology learning. The study was conducted in Patiala, Punjab, India, and nearby areas, including participants from urban, semi-urban, and rural educational settings.

Hypothesis

- 1: Students prefer 3D virtual simulation tools over physical dissection due to greater comfort, ethical acceptability, and ease of learning.
- 2: Physical dissection still plays an important role in developing practical skills and hands-on

Data were collected from both students and educators using a questionnaire. The questionnaire consisted of 10 multiple-choice questions and was self-designed. The questionnaire was created in online mode using Google Forms.

The questionnaire link was distributed to the participants through WhatsApp. Participants were selected using a convenience sampling method. They were also encouraged to share the questionnaire within their academic networks to increase participation. The responses were collected digitally.

Participation of students and educators in the survey was voluntary, and the identity of the participants was kept confidential.

The collected data were analyzed using descriptive statistical techniques. Responses to the multiple-choice questions were summarized using percentages. The data were represented using tables, bar graphs, and pie charts.

S.no.	Survey Parameter	Response Summary	Percentage
1	Exposure to live dissection	No exposure	48.8%
2	Need for animal dissection	Not needed	51.2%
3	Ethical perspective	Not ethical	65.9%
4	Usefulness of virtual tools	Helpful for learning	84.1%
5	Preferred learning method	3D virtual tools	74.4%
6	Comfort with physical dissection	Low comfort (Rating 1–2)	59.8%
7	Odor/visual discomfort	Experienced discomfort	64.6%
8	Replacement by virtual simulation	Can replace dissection	57.3%

9	Willingness to perform dissection	Not willing	59.8%
10	Integration of 3D tools	Support integration	75.6%

4.1: Summarizes the key responses obtained from the survey.

Data and Results

A total of 82 participants responded to the questionnaire. The responses were analyzed using percentages and are shown below.

Question 1: Exposure to live dissection

About 48.8% of participants had not seen or done live dissection. Around 31.7% had only seen it in videos, and only 19.5% had actual experience.

This means that many students don't have much real exposure (Figure 1).

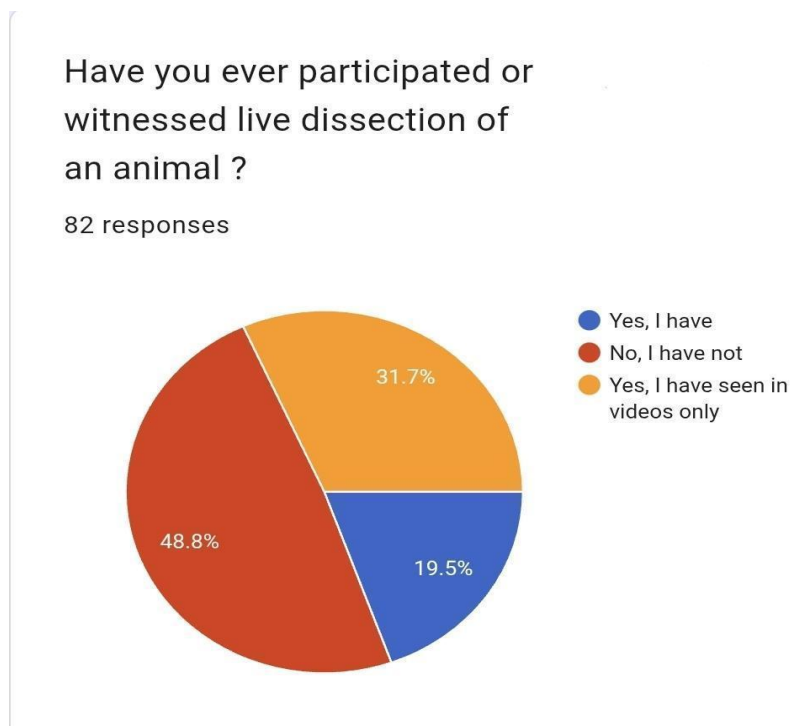


Figure 1: Exposure of students to live dissection

Question 2: Need for animal dissection today

More than half (51.2%) felt that animal dissection is not needed nowadays. About 28% still think it is necessary, and 20.7% were not sure.

This shows that opinions are changing over time (Figure 2).

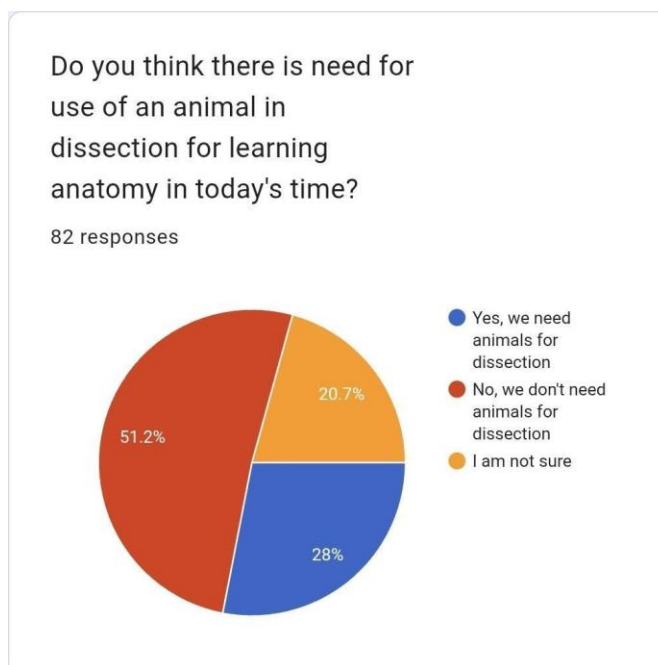


Figure 2: Opinion on need of animal dissection

Question 3: Ethical perspective

A majority (65.9%) believed that using animals in dissection is not ethical. Only 17.1% supported it, and 17.1% were unsure.

So, ethical concerns are quite strong among students (Figure 3).

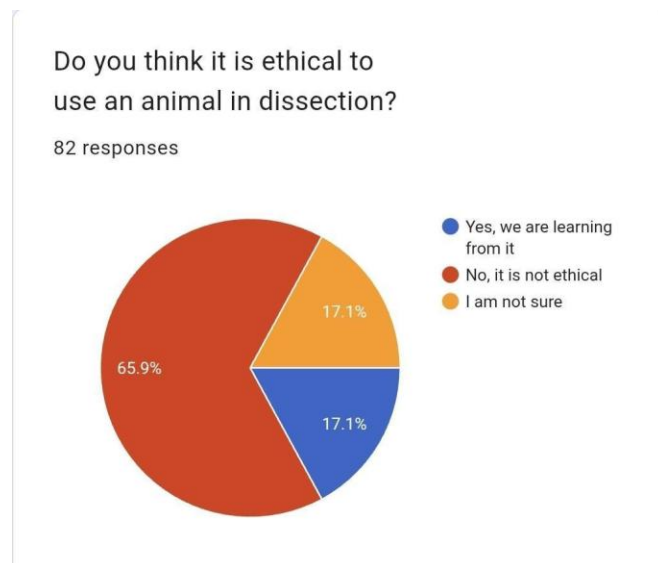


Figure 3: Ethical views on animal dissection

Question 4: Advantage of virtual tools

Most participants (84.1%) agreed that virtual tools help in better learning because they allow undoing mistakes. Only 15.9% disagreed.

This shows that students find virtual learning helpful (Figure 4).

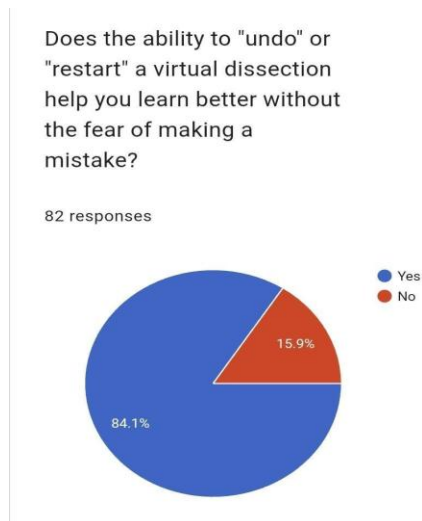


Figure 4: Role of virtual tools in improving learning

Question 5: Preferred method of study

Most participants (74.4%) preferred 3D virtual simulations. Only 17.1% preferred physical dissection, and 8.5% chose textbook diagrams.

This clearly shows that students prefer digital methods (Figure 5).

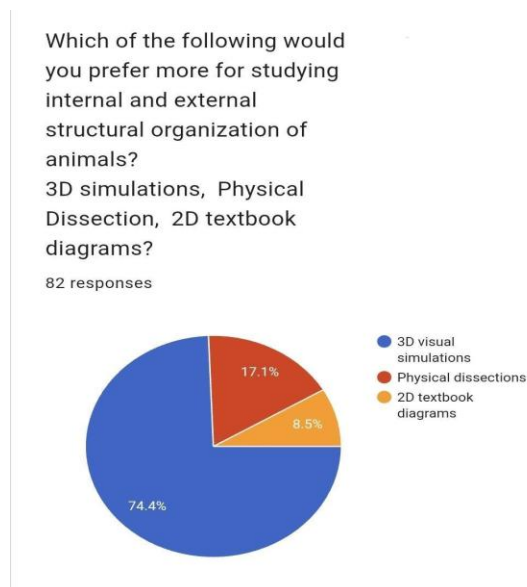


Figure 5: Preferred method for studying zoology

Question 6: Comfort level with physical dissection

Most students were not very comfortable with physical dissection. About 42.7% rated their comfort as 1, which is the lowest level. Around 20.7% chose 3 and 17.1% chose 2. Only a few students (14.6% and 4.9%) selected higher comfort levels (4 and 5).

This shows that many students are not really comfortable with dissection (Figure 6).

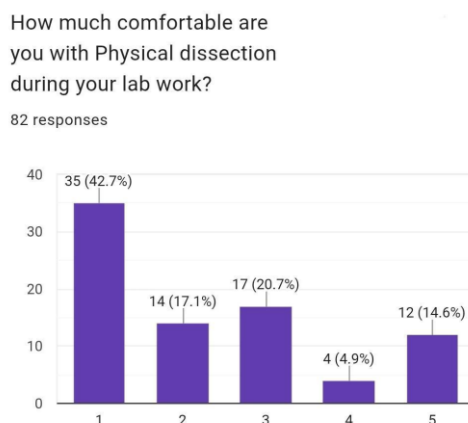


Figure 6: Comfort level with physical dissection

Question 7: Odor and visual discomfort

A majority of participants (64.6%) said that they feel odor and visual discomfort during dissection, while 35.4% said it does not bother them much.

So, discomfort is clearly common among students (Figure 7).

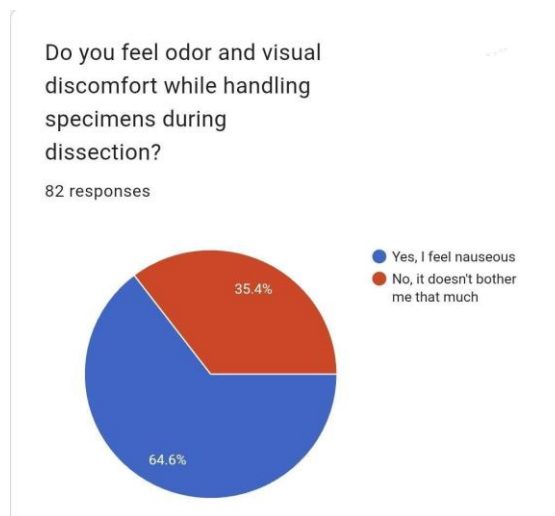


Figure 7: Odor and visual discomfort during dissection

Question 8: Replacement by virtual simulations

More than half of the participants (57.3%) felt that advanced technologies like virtual simulations can replace physical dissection. About 32.9% were not sure, and only 9.8% disagreed.

This suggests that many students are open to using modern tools (Figure 8).

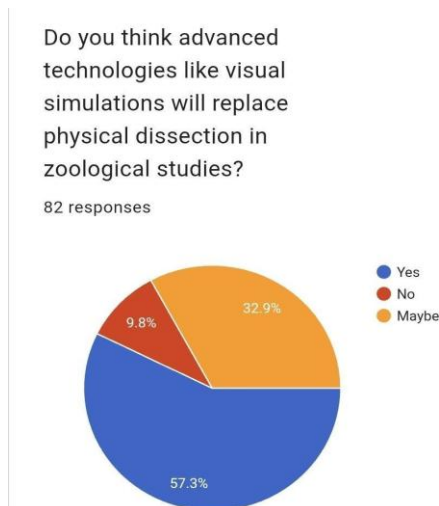


Figure 8: Opinion on replacement of dissection by virtual simulations

Question 9: Willingness to dissect

Most participants (59.8%) said they would not like to dissect an animal even if given a chance. Around 23.2% were unsure, and only 17.1% said yes.

This shows that interest in dissection is quite low (Figure 9).

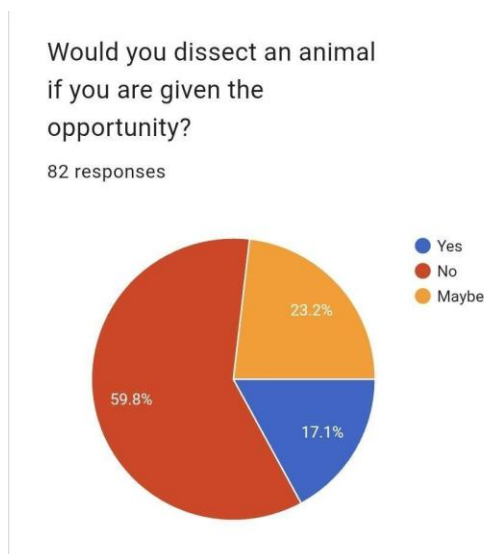


Figure 9: Willingness of students to perform dissection

Question 10: Integration of 3D virtual tools

A large majority (75.6%) supported the idea of including 3D virtual tools in the zoology curriculum. Only a small number disagreed or were unsure.

This clearly shows support for newer methods of learning (Figure 10).

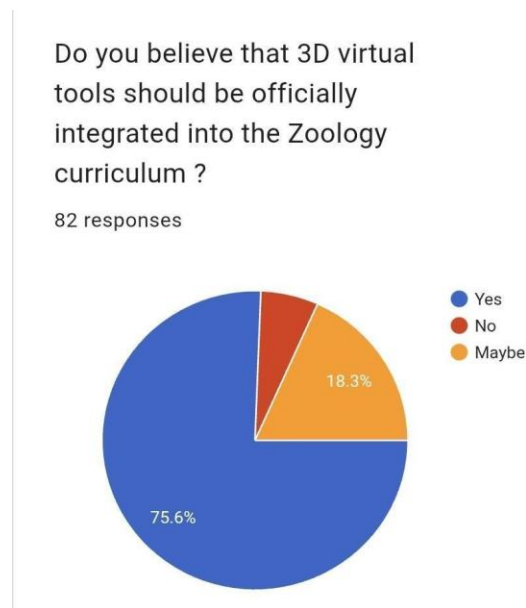


Figure 10: Support for integration of 3D virtual tools

Findings

- Many students are not comfortable with physical dissection.
- A large number experience discomfort during dissection.
- Students are open to virtual simulations.
- Interest in performing dissection is low.
- Ethical concerns are high.
- Many students have limited exposure to real dissection.
- Virtual tools are seen as helpful and easier to use.
- Most students prefer 3D simulations over traditional methods.

Discussion

The results of this study show that many students are not very comfortable with physical dissection. As summarized in Table 1 and shown in Figure 6, a large number of participants rated their comfort level very low, and 64.6% reported odor and visual discomfort (Figure 7). Most students (59.8%)

also said they would not like to dissect even if given a chance (Figure 9). These findings suggest that traditional dissection methods are becoming less acceptable to students, partly due to ethical concerns, as 65.9% of participants felt that animal dissection is not ethical (Figure 3).

At the same time, the study highlights a strong preference for virtual learning methods. As shown in Table 1, 74.4% of participants preferred 3D virtual simulations, while only 17.1% favored physical dissection and 8.5% chose textbook diagrams (Figure 5). In addition, 84.1% of respondents found virtual tools helpful for learning, mainly because they allow repetition and correction of mistakes (Figure 4). More than half of the participants (57.3%) believed that advanced virtual simulations can replace physical dissection (Figure 8), and 75.6% supported the integration of 3D virtual tools into the curriculum (Figure 10). This clearly shows that students are open to modern, digital methods that are more comfortable and engaging.

These findings are supported by previous studies. For example, Aboregela et al. (2024) and Yun et al. (2024) reported that students respond positively to virtual dissection and digital tools. Similarly, Elsayed et al. (2025) found that virtual technologies improve understanding and are widely accepted in anatomy education. Other studies by Ben Hammouda et al. (2025) and Wood et al. (2025) also showed that virtual simulations are easier to use, more interactive, and improve learning outcomes compared to traditional methods.

However, it is important to note that a small proportion of students (17.1%) still prefer physical dissection. This suggests that while virtual tools are widely accepted, traditional methods may still play a role in developing practical skills and hands-on experience.

Overall, the study indicates a clear shift from traditional dissection methods toward digital learning tools. Educational institutions should consider integrating 3D virtual simulations along with physical methods to improve student comfort, address ethical concerns, and enhance the overall learning experience.

Impact of Study

This study highlights the growing importance of digital learning tools in zoology education. The findings suggest that 3D virtual simulation tools can improve student comfort, visualization, and engagement while reducing ethical concerns related to animal dissection. The study supports the idea of combining traditional dissection methods with modern simulation tools to create a more effective and student-friendly learning environment.

Conclusion

This study examined students' perceptions of physical dissection and 3D virtual simulation tools in zoology education. The responses indicate that both methods play important roles: physical dissection provides practical exposure and skill development, while 3D simulations offer better visualization, repeatability, and reduced discomfort. The findings suggest that virtual tools cannot fully replace traditional dissection but can effectively support the learning process. Integrating digital simulations with conventional laboratory methods can create a more balanced and comfortable learning environment for students.

Although the study was conducted with a limited number of participants, it provides valuable insight into changing student preferences in zoology education. These results emphasize the potential of simulation-based learning and can help institutions plan curricula that combine ethical, practical, and modern learning approaches for better student outcomes.

References

1. Aboregela, A. M., Khired, Z., Osman, S. E. T., Farag, A. I., Hassan, N. H., Abdelmohsen, S. R., Amin, M. A., & Abdellah, A. E. (2024). Virtual dissection applications in learning human anatomy: International medical students' perspectives. *BMC Medical Education*, 24, Article 1259. <https://doi.org/10.1186/s12909-024-06218-z>
2. Ben Hammouda, S., Maoua, M., & Bouchahma, M. (2025). The effectiveness of VR-based human anatomy simulation training for undergraduate medical students. *BMC Medical Education*, 25, Article 816. <https://doi.org/10.1186/s12909-025-07402-5>
3. Blázquez-Llorca, L., Morales de Paz, L., Martín-Orti, R., Santos-Álvarez, I., Fernández-Valle, M. E., Castejón, D., García-Real, M. I., Salguero-Fernández, R., Pérez-Lloret, P., Moreno, N., Jiménez, S., Herrero-Fernández, M. J., & González-Soriano, J. (2023). The application of 3D anatomy for teaching veterinary clinical neurology. *Animals*, 13(10), Article 1601. <https://doi.org/10.3390/ani13101601>
4. Bokil, P., Relekar, A., Nandy, R., Nishanth, R. D. S., Yadav, P., & Das, D. (2024). Advancing medical education: Exploring virtual dissection tables and skill labs for innovative visualisation and simulation techniques. *Current Issues in Medical Research*, 4(1). <https://doi.org/10.58999/cijmr.v4i01.203>

5. Elsayed, A., Yousif, E., Mohamed, K. H., Samad, S., & Abdelrahim, M. A. (2025). Use of virtual technology in teaching human anatomy in medical schools: A systematic review. *Cureus*, 17(11), Article e97969. <https://doi.org/10.7759/cureus.97969>
6. Gund, M. P., Strähle, U. T., Naim, J., Waldmeyer, M., Hannig, M., & Rupf, S. (2025). Comparison of 3D-printed patient model versus animal cadaveric model in periodontal surgery block course—what is more feasible for beginners? A pilot study. *European Journal of Dental Education*, 30(1), 39–45. <https://doi.org/10.1111/eje.13090>
7. Schirone, R., Schmedding, M., Weigner, J., Werner, M., Corte, G. M., Ehlers, J. P., Klass, L. G., & Bahramsoltani, M. (2025). The impact of low-fidelity three-dimensional-printed models of the equine distal limb and the canine forelimb in teaching veterinary anatomy in practical classes. *Animals*, 15(10), Article 1380. <https://doi.org/10.3390/ani15101380>
8. Waldman, S. A., Sejdiu, Z., O'Hara, S. M., Shumsky, J. S., & Howe, C. A. (2025). A practical examination and feedback survey evaluating learners taught using physical dissections vs. 3D models of dissections of the external heart. *Medical Science Educator*. Advance online publication. <https://doi.org/10.1007/s44366-025-0064-9>
9. Wood, K. N., McWatt, S., Risha, N., & Mensink, P. (2025). Analyzing the use of digital and physical anatomical teaching models in anatomy training. *Advances in Physiology Education*, 49(2), 572–581. <https://doi.org/10.1152/advan.00030.2025>
10. Yun, Y. H., Kwon, H. Y., Jeon, S. K., Jon, Y. M., Park, M. J., Shin, D. H., & Choi, H. J. (2024). Effectiveness and satisfaction with virtual and donor dissections: A randomized controlled trial. *Scientific Reports*, 14, Article 66292. <https://doi.org/10.1038/s41598-024-66292-7>

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