

The Opportunities and Challenges in Using Virtual Anatomy

Yuliana

Anatomy Department, Faculty of Medicine, Universitas Udayana,
Jl. PB Sudirman Denpasar 80232, Indonesia. Tel. +62-222510, Fax. +62-246656.

Corresponding author

yuliana@unud.ac.id

Abstract: The COVID-19 pandemic makes the lecturer and students adapt by using online classes. One of the methods of using online classes is by delivering the anatomy material in virtual classes (virtual reality, anatomy studio). This paper aims to describe the opportunities and challenges of using virtual anatomy. This is a narrative literature review. Literature was taken from PubMed, Google Scholar, and Science Direct. The selected articles were published within 5 years. The opportunities of using virtual anatomy are students can access the material anywhere and anytime, while lecturers can give the materials of the study anywhere and anytime. The challenge is that virtual anatomy is not as perfect as 3D anatomy (cadaveric section) in giving the real anatomy sensation to the students. Therefore, virtual anatomy should be seen as an add-on for the anatomy study. In conclusion, although it is not as complete as the cadaveric section, virtual anatomy gives new opportunities for learning anatomy anywhere and anytime for students and lecturers.

Keywords: anatomy learning, cadaveric section, virtual anatomy.

Introduction

The lessons we learned during the COVID-19 pandemic will have a long-term impact on how we teach anatomy as we recover from its impacts. Although anatomy lessons will typically be given online, some subjects will benefit from in-person instruction. Most of the time, the online materials produced during the pandemic will still be used as an addition to the curriculum or as an online seminar format. Working hybrid hours will probably result in less direct interaction between teachers and students (Bond et al., 2023; Maani et al., 2023).

Even for doctors, anatomy is regarded as one of the most crucial undergraduate courses in the medical sector. It is believed that one of the most crucial aspects of medical education is learning from cadaveric specimens (Franchi, 2020). Virtual learning is not regarded as a cutting-edge approach to instruct students (Kentnor, 2015). It was once thought of as an adjunct to education rather than a necessary technique, but these days, reliance on

these new technological approaches is becoming more and more important (Alkhowailed et al., 2020; Tabatabai, 2020).

Numerous studies claim that the benefits of internet techniques are limitless, and they include being accessible whenever needed, being simpler to use, and requiring less time to reach the objective. However, there are certain drawbacks to this, like feeling cut off from the community and losing interest in learning and studying. Many people seem to find it acceptable to use this online approach as a temporary option to continue their education (Chumba et al., 2020).

The shortcomings of virtual methods are becoming more prevalent as concerns about students quitting courses because they are unable to finish them are growing. Education should be adaptable in this day, and we should work to raise the bar. The wisest course of action is to find answers along the way. Peer teaching, team-based learning, and video-based learning are a few of the current techniques utilized to carry out the

anatomy curriculum. The goal of utilizing all of these instructional strategies is to maintain students' interest and engagement in their studies (Boulos, 2022; Saverino et al., 2022).

Medical school curricula have incorporated advances in technology in the last few years. Various multimedia is developed to enhance the students' learning comprehension. Virtual reality (VR) has been used a lot lately. The positive sides of using VR are 3-D visualization, interactive, and dynamic simulation through aural, visual, and haptic senses. VR gives a lot of opportunities to recreate different worlds in a safe environment. Therefore, VR might be used for anatomy study. Some programs could offer unique tools for drawing and investigating 3-D anatomical relationships. Students are usually asked to draw anatomy structures in 2D. When using 3-D sketching tools, spatial relationships can be visualized (Kolla et al., 2020).

The majority of medical and health science colleges use cutting-edge methods to teach anatomy to their undergraduate students. Anatomical knowledge is a prerequisite for safe and competent medical treatment, and the use of virtual systems in the field of medicine can be seen as crucial to enhancing anatomical knowledge thanks to the increase in technical resources available for educational reasons. The Anatomage Table 7.0 is one of these virtual tools that has become an important anatomical tool for student teaching and medical professional training. By analyzing these subjects in light of current published findings and outlining their patterns over the COVID-19 pandemic period, this study aims to draw attention to the Anatomage Table's potential in the clinical learning process and anatomical learning. The findings showed a significant interest in and a beneficial effect (Elizabeth et al., 2022).

Funjan et al. in 2023 examined how Jordanian medical students were taught anatomy with the use of virtual anatomy dissection (Anatomage Table). The study also identifies any gender disparities in the way that students view this approach to teaching anatomy. Methods: Med students registered in Al-Balqa Applied University, a public university in Jordan, participated in this

cross-sectional questionnaire-based study. A panel of knowledgeable anatomists created a survey to find out how the students feel about using virtual anatomy dissection. The study also looked into the expectations and perceptions of students regarding how this method will affect their academic performance. Results: The study's conclusions demonstrated that the majority of students felt that the Anatomage Table improved their comprehension of anatomy lectures (64.3%) and helped them remember them (64%). Moreover, the majority of pupils were interested (72%). On the other side, for the unilateral strategy, which had only the Anatomage Table, was outperformed by the didactic approach that included both anatomical models and the Anatomage Table (80.5% vs. 30.2%, $p < 0.001$, $r = 0.9$). Notably, male and female preferences for Anatomage Table ($p < 0.001$) and assessments of the table's influence on lecture comprehension ($p < 0.001$) and anatomical structure memorizing ($p = 0.004$) showed statistically significant differences. In conclusion, the Anatomage Table is an effective teaching and learning tool for medical undergraduates. Thus far, Al-Balqa Applied University has found its application to be efficacious. It can be utilized to get around the issues with anatomy instruction at Al-Balqa Applied University's medical school and possibly other Jordanian universities (Funjan et al., 2023).

The studies showed that using this technological table to teach gross anatomy to medical students generated a lot of interest and had a beneficial effect. By enhancing knowledge in the radiological and surgical domains, anatomy provides an accurate and high-resolution description of organ structure, vascularization, and innervation as well as familiarization with radiological pictures of real patients. Additionally, using it during a pandemic might be seen as smart because it maintains anatomical and surgical training on cadaver dissection through an internet platform (Elizabeth et al., 2022; Khan et al., 2023).

Since understanding human anatomy is essential for safe and competent medical practice and is an essential component of medical curricula, it is a fundamental subject of study for medical students. To gain a thorough understanding of

anatomy and to be aware of in situ anatomical anomalies and changes, cadaveric dissection is a typical strategy that is necessary. Students can become oriented inside the human body through practice with dissection, understanding the locations of the major topographical markers, and describing anatomical three-dimensional (3D) relationships (Asari et al., 2023; Kolla et al., 2020).

As a result, dissection offers a significant benefit over textbook illustrations that are simply one dimension. Dissection enhances clinical education and is helpful for surgeons who, through the use of cadavers, can develop their safety and dexterity and test out novel surgical techniques. Medical procedure skills can be developed by practicing on human cadavers, as demonstrated by Bakalarski and colleagues' description of the function they play in learning lung auscultation (Kolla et al., 2020).

However, there are some opportunities and challenges of using virtual anatomy. This paper aims to describe the opportunities and challenges of using virtual anatomy.

Materials and Methods

This is a narrative literature review. Literature was taken from PubMed, Google Scholar, and Science Direct. The selected articles were published within 5 years. Articles were read twice to reduce bias. Selected articles were summarized and narrated.

Results and Discussion

Opportunities of using virtual anatomy

The opportunities of using virtual anatomy are students can access the material anywhere and anytime, while lecturers can give the materials of the study anywhere and anytime. For a variety of purposes, including teaching human anatomy, medical educators have been researching virtual reality (VR). A more immersive experience is offered by VR than by any 2D or 3D visualization technology, which makes it an engaging and inspiring learning environment (Khan et al., 2023; Kolla et al., 2020).

Medical students used a VR surgical simulation to learn shoulder anatomy and they discovered that it improved learning by boosting motivation. Because they are naturally curious to investigate it, students generally love a VR learning environment, according to Moro et al. (Kolla et al., 2020). For understanding anatomy, 3D tools, such as VR, are just as useful as conventional techniques (lectures, textbooks, cadaveric dissection) (Kolla et al., 2020; Yammine, 2020).

According to research comparing computer models and textbook illustrations, students who rotated a computer graphics hand model under their control considerably improved their understanding of spatial relationships compared to students who used 2D photographs. Comparatively speaking, other commercially accessible VR platforms for anatomy instruction use 3D computer-generated models of anatomical structures. As a result, the cadaveric anatomy that students would probably encounter during a cadaver dissection course is highlighted in the virtual learning environment employed in our platform. Additionally, this gives us the chance to comprehend how students perceive VR when compared directly to cadaveric dissection to understand 3D anatomical relationships. Being able to sketch in 3D and the learning experience this technology provides would be seen as a helpful addition to the available methods (Kolla et al., 2020). Cadavers, atlases, portable lecturers, and computers simulations are combined to provide better experiences in learning anatomy (Chen et al., 2020).

When teaching anatomical structures, the skull virtual learning resource (VLR) proved just as effective as the cadaver skull and atlas. Such a model can help people comprehend intricate anatomical structures with greater motivation and manageable side effects. Teaching anatomical structures using the skull VLR was just as effective as using cadaver skulls and atlases. A high level of desire and manageable adverse effects can help people grasp complex anatomical structures with the use of such a model. Modern 3D digital technology has made it possible to create more complex and lifelike VLRs, opening up possibilities for their effective supplemental application in

traditional anatomy education environments. Future generations of medical students may profit from these technologies at the outset of their education, from patient-specific VR simulations through VR anatomy models, if needed. To assess the teaching efficiency of VLRs in more thoroughly and to determine the best ways to combine VLRs with conventional medical education, more research with bigger sample sizes is required (Chen et al., 2020).

A virtual anatomy museum was created and presented to Year 1 pharmacy students from Taylor's University in Malaysia who were enrolled in the Human Anatomy and Physiology module during the summer of 2021. via universal sampling, student experiences and responses were gathered via a self-administered questionnaire. A total of 61 pharmacy students took part, 93.9% of them responded, and 82% of the students engaged in active participation throughout the virtual tour. The self-guided tour was enjoyable for more than half of the students (52.5%) and was strongly correlated with their pre-university education. The majority of students found the virtual visit to be motivating (77.0%) and enjoyable (93.4%) (Yow, 2022).

The virtual museum offers a real-world atmosphere with a self-paced learning mode, which helps students grasp anatomy courses, according to their qualitative replies. This study focused on the use of Gather's virtual anatomy visit. Town platform that increased the students' engagement in self-paced learning during their visit. It might be utilized by students as an alternate platform for visit-based learning. Town platform delivered a simultaneous, engaging, and interactive virtual anatomy museum visit. Students' engagement, motivation, sense of belonging, and interactions with their professor and classmates during the virtual visit with self-paced learning were improved. Additionally, it enhanced pupils' ability to think critically. Based on the learning experiences of the students, this online platform promoted personalized learning for the students, improved the first-year learning experience, interactions among students, and encourage lifelong learning. It may be used as a substitute platform in learning process (Yow, 2022).

Challenge of using virtual anatomy

The challenge is that virtual anatomy is not as perfect as 3D anatomy (cadaveric section) in giving the real anatomy sensation to the students. Therefore, virtual anatomy should be seen as an add-on for the anatomy study (Kolla et al., 2020). Based on the study done by Makaju and Rai in 2021, it was found that more than half of the participants (medical and dental students) stated that virtual classes were not as good as dissection, embryological, and cadaveric display. This study was done on 206 medical and dental students. Students missed cadaveric lab and face to face lectures. Almost 80% of participants missed the cadaveric dissection (Singal et al., 2021). Therefore, it was concluded that virtual classes could not be used as a permanent way to teach, they should be accompanied by a physical class (cadaveric display and dissection) (Makaju & Rai, 2021).

The difficult transition from student to licensed physician is experienced by medical professionals. While teaching and learning are the main priorities of educational systems, the Blacksmith Approach, a three-step strategy, can help students transfer more easily. It functions best as a teaching framework for any crucial preclinical course that enables learners to take on new tasks and overcome obstacles. The strategies are using more active, fun, and enjoyable learning methods for mindful learning process. Each idea was connected to the others. More investigation is needed to validate the idea that diligence yields fulfilling outcomes with fun learning activities (Shojaei et al., 2022).

Conclusions

In conclusion, although it is not as complete as the cadaveric section, virtual anatomy gives new opportunities for learning anatomy anywhere and anytime for students and lecturers. The opportunities of using virtual anatomy are students can access the material anywhere and anytime, while lecturers can give the materials of the study anywhere and anytime. The challenge is that virtual anatomy is not as perfect as 3D anatomy because it cannot offer a real-world atmosphere with a self-paced learning mode,

which helps students grasp anatomy courses, according to their qualitative replies.

Conflict of Interest: The authors declare that there are no conflicts of interest concerning the publication of this article.

References

- Alkhowailed, M. S., Rasheed, Z., Shariq, A., Elzainy, A., & El, A. (2020). Digitalization plan in medical education during COVID-19 lockdown. *Inform. Med. Unlocked*, 20(1), 1–6.
- Asari, M. A., Nurma, S., Hadie, H., Mohd, Z. I., & Simok, A. A. (2023). Anatomy Practical Session Using a Virtual Three-Dimensional Anatomy Application During the COVID-19 Pandemic. *Education in Medicine Journal*, 15(2), 95–102. <https://doi.org/10.21315/eimj2023.15.2.8>
- Bond, A. P., Kelsey, A., & Aitken, G. (2023). The future of anatomy teaching post- - pandemic: An academic viewpoint. *Anatomical Science Education*, 16(March), 1121–1133. <https://doi.org/10.1002/ase.2308>
- Boulos, A. N. (2022). Evaluation of the effectiveness of online education in anatomy for medical students during the COVID-19 pandemic. *Annals of Anatomy*, 244, 1–9. <https://doi.org/10.1016/j.aanat.2022.151973>
- Chen, S., Zhu, J., Cheng, C., Pan, Z., Liu, L., Du, J., Shen, X., & Shen, Z. (2020). Can virtual reality improve traditional anatomy education programmes? A mixed-methods study on the use of a 3D skull model. *BMC Medical Education*, 20, 1–10.
- Chumba, A. K., Omwenga, E. N., & Atemi, G. (2020). Effects of Using Computer Simulations on Learners' Academic Achievement in Physics in Secondary Schools in Ainamoi Sub-County, Kericho County. *Journal of Research Innovation and Implications in Education*, 4(1), 126–138.
- Elizabeth, A., Anna, I. C., & Oluwatosin, M. (2022). *Medical Students Perception of Anatomage: A 3D Interactive (Virtual) Anatomy Dissection Table*. 1–14.
- Franchi, T. (2020). The Impact of the Covid - 19 Pandemic on Current Anatomy Education and Future Careers: A Student's Perspective. *Anat. Sci. Educ.*, 13(3), 312–315. <https://doi.org/10.1002/ase.1966>
- Funjan, K., Ashour, L., Salameh, M., Mustafa, A., & Ahmed, M. S. (2023). Perceptions and Attitudes of Jordanian Medical Students on Using 3D Interactive Anatomy Dissection in Teaching and Learning Anatomy. *Advances in Medical Education and Practice*, August, 837–844.
- Kentnor, H. (2015). Distance Education and the Evolution of Online Learning in the United States. *Curriculum and Teaching Dialogue*, 17(1), 21–34.
- Khan, J., Baatjes, K. J., Layman-, J. I., & Correia, L. J. (2023). Online anatomy education during the Covid-19 pandemic: Opinions of medical , speech therapy , and BSc Anatomy students. *Anatomic*, 16, 892–906. <https://doi.org/10.1002/ase.2271>
- Kolla, S., Elgawly, M., Gaughan, J. P., & Goldman, E. (2020). Medical Student Perception of a Virtual Reality Training Module for Anatomy Education. *Medical Science Educator*, 30, 1201–1210.
- Maani, A., Forma, A., Brachet, A., Czarnek, K., Alashkham, A., & Baj, J. (2023). The Future of Morphological Science Education: Learning and Teaching Anatomy in the Wake of the COVID-19 Pandemic. *International Journal of Environmental Research and Public Health*, 20, 1–12.
- Makaju, S., & Rai, C. K. (2021). Virtual Anatomy Classes among the First and Second Year Medical and Dental Students of a Medical College: A Descriptive Cross-sectional Study. *J Nepal Med Assoc*, 59(240), 767–770. <https://doi.org/10.31729/jnma.6575>
- Saverino, D., Marcenaro, E., & Zarccone, D. (2022). Teaching histology and anatomy online during the COVID-19 pandemic. *Medical and Dental Education*, 35(8), 129–134. <https://doi.org/10.1002/ca.23806>
- Shojaei, A., Feili, A., Kojuri, J., Norafshan, A., & Bazrafkan, L. (2022). The blacksmith approach: a strategy for teaching and learning in the medical anatomy course (a qualitative study). *BMC Medical Education*, 22(728), 1–13.
- Singal, A., Bansal, A., Chaudhary, P., Singh, H., & Patra, A. (2021). Anatomy education of medical and dental students during COVID-19 pandemic: a reality check. *Surgical and Radiologic Anatomy*, 43(4), 515–521. <https://doi.org/10.1007/s00276-020-02615-3>
- Tabatabai, S. (2020). COVID-19 impact and virtual medical education. *Journal of Advances in Medical Education & Professionalism*, 8(3), 140–143. <https://doi.org/10.30476/jamp.2020.86070.1213>
- Yamine, K. (2020). Evidence-Based Anatomy. *Clinical Anatomy*, May 2014. <https://doi.org/10.1002/ca.22397>
- Yow, H. (2022). A Case Study of Virtual Anatomy Museum: Facilitating Student Engagement and Self-paced Learning through an Interactive Platform. *International Journal of Information and Education Technology*, 12(12), 1345–1353. <https://doi.org/10.18178/ijiet.2022.12.12.1758>

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