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The Use of Virtual Dissection Tables: A Promising Tool for Studying Human Anatomy

Arben Mitrushi[1], Anila Kristo[1], Gezim Xhepa[1], Fatmir Gorenca[1], Nikollaq Leka[1], Gentiana Qirjako[2*], Arvin Dibra[3], Dorina Ylli[4], Xheladin Çeka[1**]

[1] Department of Morphology, Faculty of Medicine, University of Medicine, Tirana
[2] Department of Public Health, Faculty of Medicine, University of Medicine, Tirana
[3] Academic Senate of the University of Medicine, Tirana
[4] Projects Office of the University of Medicine, Tirana
** Head of the project "Digitalization of Virtual Dissection and Restructuring of the Anatomy Laboratory Unit"

Abstract

Introduction: In the recent years, the anatomical field at our University has experienced positive advancements in academic infrastructure. These include the creation and enhancement of digital-electronic demonstrations through the use of digital atlases integrated into interactive computer systems, implemented as a solution to the lack of cadaveric dissection opportunities. Despite these improvements, the need for a three-dimensional (3D) demonstration of anatomical structures remained unaddressed. As part of a contemporary reform in didactic infrastructure, our laboratories were recently equipped with virtual anatomy dissection tables. These innovative tools offer a digitized anatomical system that projects gross anatomical structures from human cadavers onto a life-sized touchscreen table, enabling students to perform virtual dissections.

Aim: To evaluate the effectiveness of virtual anatomy tables in studying human anatomy.

Subjects and method: A cross-sectional survey was conducted based on student feedback. The survey compared two methods: the traditional digital-electronic atlas system and the virtual anatomy tables. The aim was to evaluate and compare their experiences in teaching and learning anatomy during a three-month period (October 2024–December 2024). First- and second-year medical students from the Faculty of Medicine, along with first-year students from the Faculty of Dentistry at the University of

Address for correspondence: Gentiana Qirjako*, Department of Public Health, Faculty of Medicine, University of Medicine, Tirana, Albania. E-mail: gentaqirjako@gmail.com

Medicine, Tirana, were invited to complete a questionnaire.

Results: A total of 412 students completed the survey. The results were compelling, with 94% of students recognizing the value of virtual anatomy tables as a teaching and learning tool; 30% preferring virtual anatomy tables exclusively and 64% endorsing an integrated approach. Students highlighted several advantages of virtual dissection, including enhanced perception and memorization of anatomical structures, superior 3D visualization, the ability to perform cuts in different planes (facilitating cross-sectional anatomy learning) and improved interaction and focus during laboratory sessions.

Conclusion: These findings position the virtual dissection as a promising and transformative method for studying human anatomy.

Keywords: virtual dissection table, digital atlases, anatomy

INTRODUCTION

The study of human anatomy plays a fundamental role in the training of medical professionals. As one of the essential basic sciences in medicine, it provides medical students with crucial knowledge necessary for their development as future physicians. This knowledge significantly influences their ability to diagnose and treat numerous diseases. Historically, cadaveric dissection has been the cornerstone of learning human anatomy, offering a tangible, three-dimensional exploration of the human body. Medical students at various levels of training have long believed that dissection enhances their understanding of anatomy and its clinical applications. Their experiences support the view that dissection is key to developing clinical skills (1, 2,3,4).

However, in recent years, medical curricula have gradually moved towards restricting the use of cadavers for various reasons. These include ethical concerns regarding the procurement of bodies, the inability to reuse cadavers after dissection, leading to a shortage of cadaveric specimens, the time-consuming nature of the dissection process, a lack of adequately trained pedagogical staff, the potential stress caused by dissection, the high costs of maintaining dissection laboratories, and the inadequate availability of cadavers due to large class sizes (5,6,7).

At the same time, advancements in technology and computer-based tools have had a profound impact on many fields, including medical education and the study of anatomy (8,9,10,11). In this context, virtual dissection has emerged as an alternative to traditional cadaveric dissection, addressing many of the limitations mentioned above. Among the most prominent of these technological advancements are the virtual dissection tables, developed by a 3D medical technology company in California, in collaboration with Stanford University's Clinical Anatomy Division. These virtual dissection tables replace physical cadavers with highly detailed digital representations of real human bodies, including male, female, geriatric, and pregnant models. The virtual anatomy tables are constructed from frozen cadaveric slices that are scanned and digitized, allowing for interactive manipulation such as layer-by-layer dissection, cutting in various anatomical planes, and visualizing anatomical structures in real-time. Additionally, these tables provide opportunities for practicing clinical procedures, including endoscopy, ultrasound, coronary angiography etc., all of which can be performed on real human body models (12,13,14,15,16).

In our medical university, which has faced significant challenges in securing cadaveric materials, digital tools have become a valuable alternative for practical demonstrations during laboratory sessions. For years, we have utilized digital atlases installed on computer systems, an interactive method for teaching anatomy, though one that lacks the three-dimensionality and hands-on experience provided by physical dissection.

As part of the ongoing modernization of our educational and research infrastructure, the Normal Anatomy laboratories were recently equipped with virtual dissection tables. To assess the impact of this technology on medical students' learning experiences, we conducted a cross-sectional survey to gather their feedback on the use of virtual dissection tables in teaching anatomy.

SUBJECTS AND METHOD

The first/second-year medical students of the Faculty of Medicine, as well as first-year students of the Faculty of Dentistry at the University of Medicine, Tirana, were asked to complete a questionnaire to compare their experiences during a three-month period (October 2024–December 2024) in teaching and learning anatomy.

The comparison focused on demonstrations utilizing electronic atlases and virtual dissection tables. Students were asked to evaluate the methods based on their efficiency (very efficient, efficient, or slightly efficient) and compare the two approaches–virtual dissection tables versus digital atlases–regarding spatial perception, memorization of anatomical structures, interactivity, and attention focus during anatomy courses. Additionally, students were asked to indicate their overall preferred method. This was a cross-sectional study, with data collected between December 11 and 19, 2024.

The questionnaires were distributed by faculty staff, who clearly explained the study's purpose and the importance of the students' feedback at the beginning of the questionnaire. Participation was voluntary, and students could withdraw at any time without consequences.

After collection, the data were accurately entered into a Microsoft Excel table and analyzed statistically. Descriptive statistics were used, and percentages of categorical variables were calculated.

Ethical Considerations

Ethical approval for the study was obtained from the University's Ethics Committee. Participation was anonymous, and no personally identifiable information was collected. Students were informed about the confidentiality of their responses and that the data would be used solely for academic and research purposes.

RESULTS

A total of 412 students completed the survey. The efficacy of the two methods – digital atlases and virtual dissection tables – was rated as very good by nearly 80% of students (81% for digital atlases and 79.3% for virtual dissection tables), with no significant differences between the two methods (Fig. 1).

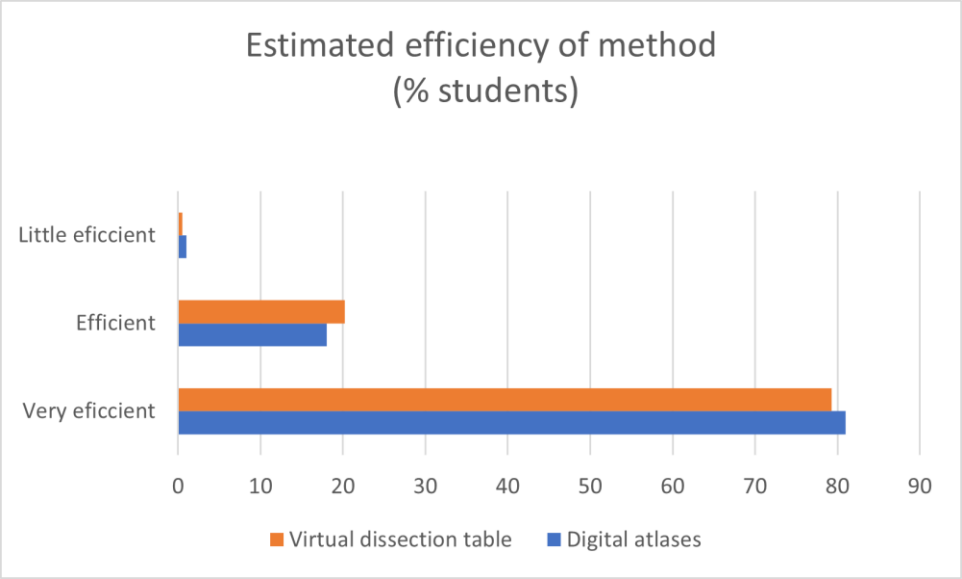

Figure 1. The estimated efficiency of the two methods: digital atlases and virtual dissection tables

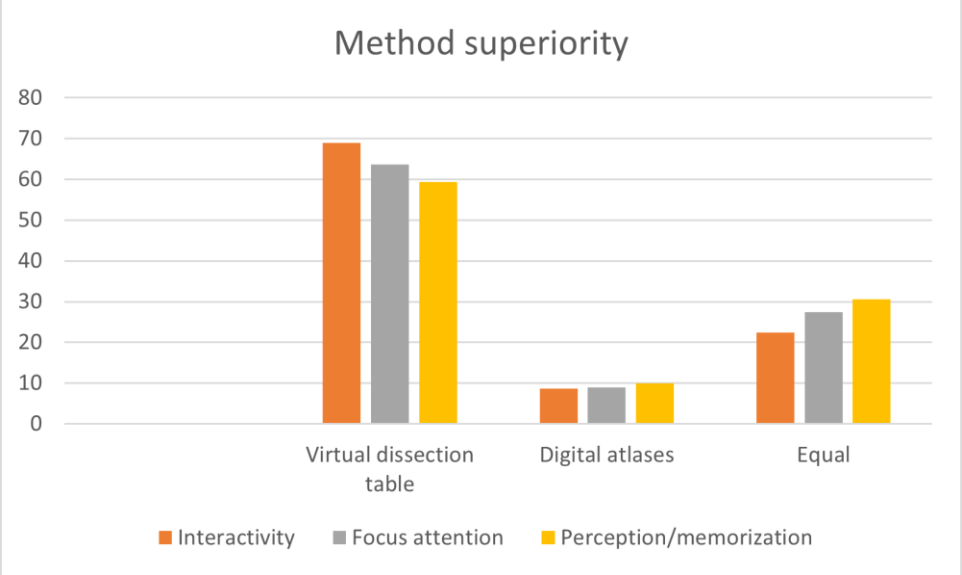

Figure 2. Method superiority in terms of interactivity, focus attention and perception/memorization of anatomical structures during laboratories sessions

In terms of method superiority, the virtual dissection tables were found to be more effective than the digital atlases in the following areas: interactivity (69% vs. 8.6%), attention focus during anatomy laboratory sessions (63.6% vs. 9%), and spatial perception and memorization of anatomical structures (59.4% vs. 10%) (Fig. 2). However, a number of students – 22.4% for interactivity, 27.4% for attention focus, and 30.6% for perception/memorization – considered both methods equally effective.

Students were asked for their opinions on the advantages of the virtual human anatomy platform, such as layer-by-layer dissection and

cutting in various anatomical planes. A significant 92.4% and 86.6% of students, respectively, considered these two features to be very important for studying anatomy (Fig. 3).

The digital anatomy tables also include clinical cases, and students were asked when they believed these cases should be introduced – either during anatomy courses or later in clinical courses. Of those surveyed, 68.5% expressed interest in studying clinical cases during anatomy sessions (Fig. 3).

Finally, students were asked to indicate their overall preferred method for teaching and learning anatomy. According to the survey, 30% of students preferred exclusively virtual dissection tables, 6% preferred only digital atlases, and 64% of students favored an integrated approach, using both methods alternately (Fig. 4).

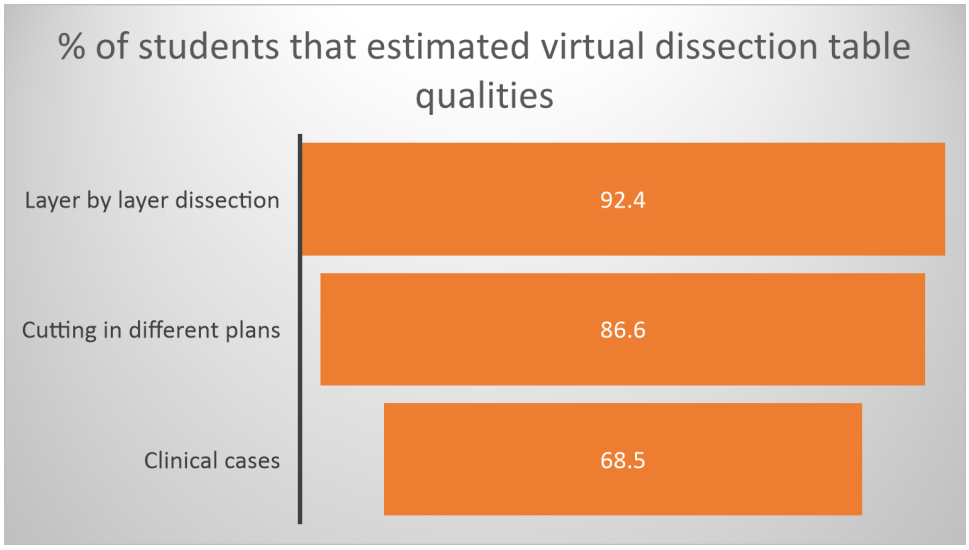

Figure 3. The percentages of students that estimates digital anatomy table advantages as very important

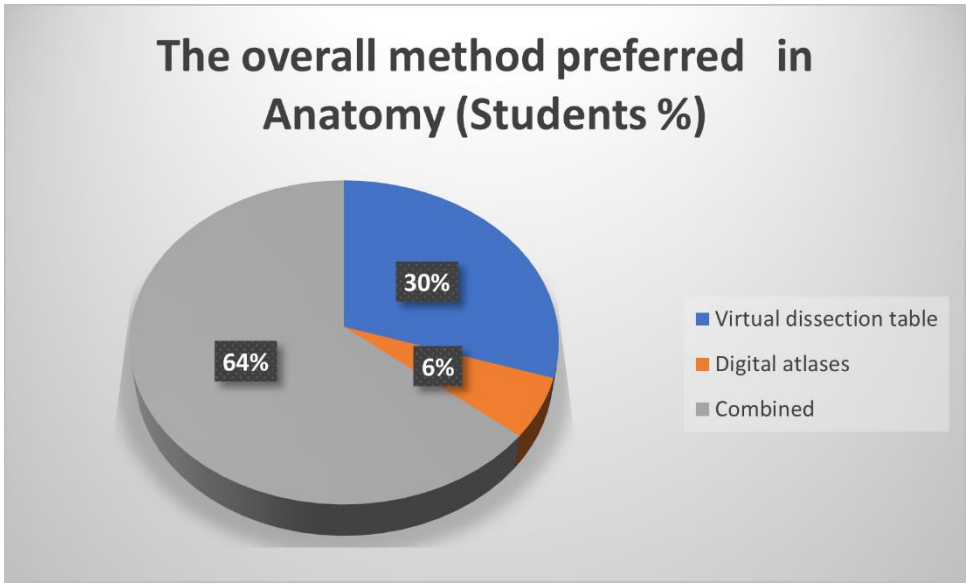

Figure 4. The overall estimated preferred method in studying Anatomy

DISCUSSION

Numerous studies have been conducted by universities evaluating the use of virtual dissection tables compared to traditional cadaveric dissection as the primary method for teaching and learning gross anatomy. The results of these studies increasingly favor the use of virtual tables in addition to cadaveric dissection. As these studies have shown, the use of virtual tables has been found to reduce the costs of maintaining anatomical laboratories, shorten dissection time, and enhance learning outcomes by improving students' test performance (17,18,19,20).

These studies typically rely on test performance and/or students' opinions, and the results support an integrated approach that combines virtual dissection tables with traditional methods such as cadaveric dissection, prosections, or computer-based tools like digital atlases, as seen in our study. This integrated curriculum not only addresses some of the challenges associated with cadaveric dissection, as mentioned above, but also improves spatial perception, memorization, and overall learning of human anatomy by increasing students' performance (6, 21,22,23).

The Interactive Virtual Anatomy System, in particular, supports learning cross-sectional anatomy, which is crucial in anatomical imaging. It also includes radiological imaging (CT/MRI), facilitating the integration of anatomy and radiology within the curriculum (13,19,24). As our survey results suggest, 86.6% of students appreciated the ability to make cuts in different planes offered by the virtual dissection table. This feature is particularly valuable for residents in radiology, who can leverage these tools to enhance their anatomical knowledge.

While the virtual human anatomy platforms widely used for pedagogical purposes, it also holds great potential for clinical and radiological studies. It serves as a diagnostic tool, using 3D reconstructions of radiological images. Accurate disease diagnosis requires deep knowledge of human anatomy, and the virtual dissection tables can be an excellent diagnostic tool, as radiological images from patients can be uploaded and reconstructed in 3D using the 3D Virtual Anatomy software. This capability can assist surgical residents in better planning interventions in specific cases (25, 26, 27,28).

A recent large systematic review concluded that the use of virtual human anatomy platform improved learning outcomes in anatomy, radiology, and surgery when combined with traditional methods (15). We should encourage our residents to engage in clinical, surgical, and radiological studies using the opportunities provided by virtual dissection tables.

Cadavers may present variations in anatomy that should be identified during virtual dissections and demonstrated to students, thereby enhancing their anatomical understanding (29). The table is also equipped with clinical cases, and our study found that 68.5% of students expressed interest in exploring them during anatomy courses. However, these cases can be more effectively studied by students in higher-grade years during

clinical courses, and particularly by residents, especially in fields like surgery and imaging.

CONCLUSION

As indicated by the results of our survey based on students' opinions, virtual dissection tables are a promising tool for learning human gross anatomy. Virtual dissections provide a better understanding of 3D anatomy, enhance spatial perception and memorization of various anatomical structures, and allow for the study of cross-sectional anatomy, which is fundamental to anatomical imaging. Our study suggests that virtual dissection tables, when used alongside digital atlases, offer an improved approach to studying anatomy. These tools should be utilized widely, not only by students during anatomy courses but also by advanced students in higher-grade years and residents. This is due to the wide range of opportunities offered, including the study of clinical cases, physiological simulations, exploration of clinical procedures, and the 3D reconstruction of radiological images.

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Conflict of Interest Statement: The authors declare that have no conflict of interest.

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