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ORIGINAL ARTICLE

EVALUATING THE PERCEPTIONS AND EFFECTIVENESS OF TRADITIONAL ANATOMY MODELS AND DIGITAL DISSECTION TABLES IN ANATOMY LEARNING

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Abstract

Background: Anatomy education is a keystone of medical training, crucial for developing clinical skills across various specialties such as surgery and radiology. Traditionally, anatomy has been taught using physical models, offering tactile engagement and spatial understanding. However, the advent of digital innovations, particularly virtual anatomy tables, has introduced high-resolution, interactive learning experiences, prompting a need to evaluate their educational value in comparison to conventional tools.

Objective: To compare the effectiveness, engagement, and preferences of undergraduate medical students regarding traditional anatomy models and 3D digital anatomy tables at Gomal Medical College.

Material and Methods: A descriptive cross-sectional survey was conducted among 175 first- and second-year MBBS students at Gomal Medical College from October 2024 to March 2025. A census sampling approach was applied. Data were collected through a self-developed, validated questionnaire. The Anatomage Digital Anatomy Table ,The Asclepius Anatomy Table, developed by Sunglasses Inc. (Taiwan Main Orthopedic Biotechnology Co., Ltd., Taiwan),was used alongside traditional anatomical models. Descriptive and inferential statistics applied using SPSS v30.

Results: Among respondents, 92 (52.6%) were male and 83 (47.4%) female, with a mean age of 19.8±1.2 years. While 95 (54.3%) preferred traditional models and 108 (61.7%) favored digital tables, 150 (85.7%) supported integrating both. Digital tables were perceived as more engaging (74.3%) and helpful for 3D understanding (68.6%), whereas traditional models enhanced tactile and spatial learning (65.7%) and long-term retention (57.1%).

Conclusion: Both digital and traditional anatomy tools have distinct strengths. Integrating digital tables for visualization with physical models for tactile learning may optimize anatomy education in modern medical curricula.

Keywords: Anatomy; Education, Medical, Undergraduate, Teaching Materials, Students.

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Introduction:

Anatomy forms the foundation of medical education, providing the foundation for clinical competence in all medical specialties, particularly surgery, radiology, and physical therapy. Traditional teaching through cadaveric dissection and physical models has long been regarded as essential, yet each approach presents its own pedagogical challenges and logistical constraints[1,2]. With the growing shift toward technology-enhanced learning, digital tools such as three-dimensional virtual anatomy tables have gained increasing popularity[3, 4].

These tools allow visualization and manipulation of full-scale virtual cadavers reconstructed from CT and MRI datasets, enabling learners to “dissect” and explore anatomy in an interactive way. The virtual tables have

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attractive graphics and appeal to the eye that attracts the attention of learners particularly those who are technologically inclined[5,6]. In era of artificial intelligence and technological advancement, the virtual tables have attractive graphics and appeal to the eye that attracts the attention of learners[7].

Several studies have shown that using virtual anatomical dissection tables significantly enhances students' learning experiences and helps improve their long-term knowledge retention[8].

Some researchers have compared virtual anatomical dissection tables with traditional cadaver-based dissections and found that students consider the virtual tables easier to use and more intuitive to understand[9].

However, the educational value of these digital systems compared with conventional tactile models remains under-explored, particularly in low-resource contexts such as Pakistan.

Despite their growing use, limited local evidence exists regarding students' comparative perceptions of digital tables and traditional models, nor is it clear how these tools influence engagement, understanding, and long-term retention. This study addresses that gap by directly evaluating the perceived effectiveness and preferences of pre-clinical medical students using both methods.

Material and Method:

Study Design:

A descriptive cross-sectional survey was conducted at the Department of Anatomy, Gomal Medical College, D.I. Khan, from October 2024 to March 2025.

Study Population, place & duration:

All first- and second-year MBBS students who had attended anatomy sessions using both conventional models and the Anatomage Digital Anatomy Table , The Asclepius Anatomy Table, developed by Sunglasses Inc. (Taiwan Main Orthopedic Biotechnology Co., Ltd., Taiwan),were included. Students who had missed more than 25% of anatomy practical sessions or had prior exposure to other 3D software (e.g., Complete Anatomy or Visible Body) were excluded.

Sampling Technique and Sample Size:

A census sampling approach was adopted, all eligible students were invited to participate and 175 students provided usable responses. Therefore, no sample size calculation was required. Participants were told to sign an informed written consent.

One hundred and seventy-five students (175) were in this study. The sample was computed at a confidence interval of 95 percent and a margin error of 5 percent assuming maximum variability (0.5 %). The sample size was approximately 148 participants. Since 175 students responded, the achieved sample size exceeded the minimum requirement, ensuring adequate statistical power & precision for the study objectives.

Data Collection Tool:

Data were collected using a self-developed structured questionnaire, created after literature review and consultation with anatomy education experts. The data collection tool was content-validated by three senior anatomists and pilot-tested on 15 students, whose responses were excluded from final analysis. Cronbach's alpha was 0.82, indicating high internal consistency. The effectiveness was assessed using dichotomous scales (Yes/No).

Demographic Variables:

The demographic variables included:

Gender (Male/Female),

Age (in years),

Residence (Urban/Rural).

Data Analysis:

The Statistical Package for the Social Sciences (SPSS) version V.30 was used in data entry and analysis.

The age, a continuous variable was indicated as the mean and the standard deviation (SD).

Categorical variables such as gender and residence were provided in frequency and percentages.

Responses on dichotomous scales were also presented as frequencies and percentages. Appropriate descriptive statistics were used to summarize the findings, and cross-tabulations were performed to identify trends or associations between demographic factors and students' preferences.

Ethical Considerations:

Ethical standards were observed during the study. Permission to carry out the research was granted by the Ethical Review Committee of Gomal Medical College, D.I.Khan (IRB number 243/GJMS/JC). The research was voluntary, and the confidentiality of data was kept during the research process.

Results:

Demographic Characteristics of Respondents:

A total of 175 medical students participated in the study. The demographic distribution is summarized in Table 1.

Table 1: Demographic Profile of Respondents (N = 175)

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	92	52.6%
	Female	83	47.4%
Residence	Urban	110	62.9%
	Rural	65	37.1%
Age (Mean ± SD)	-	-	19.8 ± 1.2 years

Student Preferences and Perceptions of Learning Tools:

Table 2: Student Preferences Between Anatomy Models and Digital Tables Percentage (%)			
Preference	**Response**	**Frequency (n)**	**Percentage (%)**
Prefer traditional anatomy models	Yes	95	54.3%
	No	80	45.7%
Prefer digital anatomy tables	Yes	108	61.7%
	No	67	38.3%
Believe both tools should be integrated	Yes	150	85.7%
	No	25	14.3%

Table 3: Perceived Effectiveness of Learning Tools No (n, %)			
Effectiveness Metric	**Tool**	**Yes (n, %)**	**No (n, %)**
Improved understanding of 3D anatomical structures	Digital Tables	120 (68.6%)	55 (31.4%)
Better tactile and spatial learning experience	Anatomy Models	115 (65.7%)	60 (34.3%)
Easier to visualize anatomical relationships	Digital Tables	105 (60.0%)	70 (40.0%)
More engaging and interactive	Digital Tables	130 (74.3%)	45 (25.7%)
Enhances long-term retention of knowledge	Anatomy Models	100 (57.1%)	75 (42.9%)

These results suggest that while digital tables are perceived as more interactive and visually effective, a significant number of students still value the tactile and spatial learning advantages offered by traditional models. The majority of students advocated for an integrated use of both tools in anatomy education.

Discussion:

This research project took the chance to test the effectiveness of the conventional anatomy models as compared to the digital anatomy tables with respect to the learning experiences process of first- and second-year medical students. The results indicated significant tendencies in questions on student preference, perceptions of the learning outcomes, and usefulness of incorporating both instruments in the anatomy curriculum.

According to table No: 1 about 54.3% participants preferred traditional models of anatomy, attributing importance to the fact that they are able to create both the sense of touch and spatial perception. This is consistent with previous studies that argue in favor of the role of physical models in fostering kinesthetic learning, which is a critical concept in anatomy education1, 10. A study conducted at the University of Lahore also emphasized the value of cadaveric and model-based teaching in enhancing students' tactile memory and practical understanding of human anatomy6.

As mentioned in table No: 2 a slightly larger proportion of students (61.7%) preferred digital anatomy tables due to their improved visual presentation, multimedia integration, and interactive 3D visualization. While 68.6% of respondents stated that digital tables improved their understanding of anatomical relationships as shown in table No: 3. This aligns with research by Sarwar et al. (2022), who reported that virtual anatomy tools significantly enhanced spatial orientation and visual learning among Pakistani medical students[7, 8, 11, 12,13] .A key lesson learned during this research is that the majority—85.7%—favored an integrated method, meaning both traditional and digital tools should be combined. This resonates with the wider academic narrative that hybrid learning, blending tactile engagement with technological innovation, yields the best educational outcomes[11, 12,13.]

However, a cross-sectional study by Mahindra et al. (2017) found no statistically significant difference between the two groups[14]. Similarly, Tanzeela et al. (2020) also reported a non-significant result ($p = 0.24$)[15.]

The results reflect the growing heterogeneity in medical education and the importance of curricular flexibility[16, 17,18.]

When comparing advantages, conventional models were superior for tactile interaction and long-term retention, while digital tables were favored for visual analysis and learner engagement. These findings imply that each modality plays a distinct and complementary role in anatomy education[19, 20] .

No meaningful differences in preference were found regarding gender or residence, with generally consistent perceptions across the cohort. Given that the average age of participants was 19.8 years- during the pre-clinical phase - these insights are particularly relevant for curriculum development in foundational medical sciences.

Implications for Medical Education:

These findings support the significance of the balance in terms of innovations and traditional approaches to education. Although digital anatomy tables are very useful in computational visualization and interactivity, physical models are necessary in offering a spatial and realistic learning process. Comprehensive curriculum, which incorporates the two tools, can potentially improve understanding, retention, and learner satisfaction[6].

Limitations:

Self-reported data do not give realistic results of academic performance or knowledge retention.

Recommendations:

A future research is supposed to use objective academic measures to prove the connection between student perceptions and learning achievements. The longitudinal study is also suggested to assess the long-term outcome of the application of blending anatomy education in medical practice and the knowledge maintenance.

Conclusion:

A future research is supposed to use objective academic measures to prove the connection between student perceptions

and learning achievements. The longitudinal study is also suggested to assess the long-term outcome of the application of blending anatomy education in medical practice and the knowledge maintenance.

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