**Student's Journal of Health Research Africa**
**e-ISSN: 2709-9997, p-ISSN: 3006-1059**
**Vol.6 No. 6 (2025): June 2025 Issue**
**https://doi.org/10.51168/sjhrafrica.v6i6.1959**
**Original Article**

# Comparative study of traditional versus digital anatomy teaching using virtual dissection tools: A quasi-experimental study.

***Dr. Deepika Vazir[1], Dr. Ashok Aenumulapalli[2], Dr. Sravanthi Repalle[3]****

*[1]Associate Professor, Department of Anatomy, Government Medical College, Mulugu, Telangana, India.*
*[2]Associate Professor, Department of Anatomy, Prathima Relief Institute of Medical Sciences, Warangal, Telangana, India.*
*[3]Associate Professor, Department of Anatomy, Government Medical College, Narsampet, Warangal, Telangana, India.*



## Abstract

**Background:** Anatomy forms the cornerstone of medical education. While cadaveric dissection has long been the standard method for anatomy teaching, the emergence of digital platforms offering virtual dissection tools has introduced new opportunities for interactive and remote learning—especially during the COVID-19 pandemic.

**Objective:** To compare the effectiveness of traditional cadaveric dissection and digital anatomy instruction using virtual dissection tools in enhancing learning outcomes among undergraduate medical students.

**Methods:** A quasi-experimental study was conducted among 120 first-year MBBS students at a tertiary medical college. Students were randomized into two groups: Group A (n=60) received traditional dissection-based teaching, and Group B (n=60) received digital instruction using tools like 3D anatomy software and the Anatomage Table. Pre- and post-intervention assessments were conducted using MCQs and OSPEs. A feedback questionnaire evaluated student perceptions of clarity, engagement, and accessibility. Statistical analysis included paired and unpaired t-tests ($p<0.05$).

**Results:** Both groups showed significant post-test improvements ($p<0.001$). Group B had a slightly higher mean score ($78.2 \pm 6.5$) than Group A ($75.6 \pm 7.1$), though not statistically significant ($p=0.067$). Students in Group B reported greater satisfaction with visual clarity (92%), interactivity (87%), and accessibility (89%), while Group A appreciated the tactile learning and real-life anatomical variation of cadaveric dissection.

**Conclusions:** Virtual dissection tools are effective alternatives to traditional methods, enhancing engagement and visualization. However, each method has unique strengths that support anatomy learning.

**Recommendations:** A blended approach combining digital tools with cadaveric dissection is recommended to deliver a comprehensive and immersive anatomy education. Further studies should explore long-term learning outcomes and cost-effectiveness.

***Keywords:*** *Anatomy education; Cadaveric dissection; Virtual dissection tools; Digital learning; Anatomage; Medical education; Teaching methods; Comparative study.*

***Submitted:*** *2025-04-07* ***Accepted:*** *2025-06-10* ***Published:*** *2025-06-30*

***Corresponding Author:*** *Dr. Sravanthi Repalle*
*Email:* ***sravanthidasyam@yahoo.com***
*Associate Professor, Department of Anatomy, Government Medical College, Narsampet, Warangal. Telangana, India*

Student’s Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



## Introduction

Anatomy serves as one of the cornerstones of medical education, laying the groundwork for a comprehensive understanding of the human body’s structure and its functional integration. The accurate knowledge of anatomical relationships is not only essential for subjects such as physiology, pathology, and surgery but also plays a critical role in clinical decision-making and procedural competency throughout a medical professional's career. Historically, cadaveric dissection has been revered as the most effective and immersive approach to anatomy education, offering students the opportunity to explore human variation, develop manual dexterity, and internalize respect for human life and mortality [1–3].

Despite its pedagogical strengths, the cadaver-based model has increasingly faced challenges. The procurement and maintenance of cadavers involve ethical considerations, regulatory limitations, high financial burden, and significant infrastructural requirements, including ventilation systems, preservation facilities, and trained personnel [4]. Moreover, issues such as limited access, exposure to chemical preservatives like formalin (which can pose health risks), and the inability to repeat dissections multiple times restrict the flexibility and accessibility of traditional methods. In rapidly growing medical institutions, these limitations are further compounded by increasing student-teacher ratios and the pressure to adopt more scalable and student-centred approaches [5].

In response to these challenges, technological advancements have introduced a new paradigm in anatomy teaching—virtual dissection tools and digital anatomy platforms. These tools leverage three-dimensional (3D) visualization, augmented reality (AR), and interactive simulations to allow learners to explore complex anatomical structures with precision and repeatability. Systems such as the Anatomage Table, Visible Body, and 3D Organon provide high-resolution, real-time rendering of anatomical models that can be virtually dissected layer by layer. These digital platforms not only allow for self-paced, student-driven learning but also offer portability, consistency in anatomical representation, and integration with multimedia clinical cases and radiological imaging [6–8].

The sudden shift to online education during the COVID-19 pandemic accelerated the integration of digital platforms into medical curricula. Institutions worldwide adopted virtual learning environments to mitigate the absence of in-person dissections, raising important questions about the relative effectiveness of digital tools in comparison to conventional methods [9,10]. Although early adoption was driven by necessity, many educators and learners recognized the potential of virtual tools to enhance visualization, spatial reasoning, and engagement—especially among students who are digital natives.

However, despite the growing popularity of digital solutions, debates persist regarding their adequacy in replicating the tactile, emotional, and spatial learning afforded by traditional cadaveric dissection. Critics argue that digital models may lack anatomical realism, variability, and the emotional depth of interacting with human remains, potentially weakening the development of professional values and surgical competencies [11]. Furthermore, the lack of haptic feedback and practical exposure may impede students’ readiness for hands-on clinical procedures.

In this context, there is a critical need to evaluate the comparative effectiveness of traditional and digital approaches to anatomy teaching. While several studies have independently validated the utility of each modality, few have directly compared student outcomes, engagement, and satisfaction in a controlled academic setting.

Therefore, the present study aims to conduct a comparative analysis of traditional cadaveric dissection and digital anatomy teaching using virtual dissection tools among first-year MBBS students. By assessing pre- and post-teaching performance, student perceptions, and subjective learning experiences, this study seeks to inform evidence-based

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



recommendations for anatomy curriculum development in a rapidly evolving educational landscape.

## Materials and Methods

### Study Design and Setting

This prospective, quasi-experimental comparative study was conducted between January 2023 and December 2024 across four tertiary medical teaching institutions in Telangana, India: Government Medical College, Narsampet; Kakatiya Medical College, Warangal; Government Medical College, Mulugu; and Prathima Relief Institute of Medical Sciences, Warangal. All institutions are affiliated with the Kaloji Narayana Rao University of Health Sciences (KNRUHS) and follow a competency-based MBBS curriculum. These centers were chosen for their established anatomy departments, each equipped with cadaveric dissection laboratories and digital platforms such as the Anatomage Table, ensuring a balanced comparison of teaching modalities. Student recruitment was conducted from January 1 to January 15, 2023, following an orientation session.

### Study Population and Sampling

A total of 120 first-year MBBS students enrolled during the 2023–2024 academic session participated in the study. Recruitment followed an orientation session in which the study objectives and procedures were explained, and written informed consent was obtained from all participants. Random allocation into two equal groups was carried out using a computer-generated random number sequence prepared by an independent faculty member not involved in teaching or assessment. Group A (n = 60) received traditional anatomy instruction through cadaveric dissection and standard lectures, while Group B (n = 60) received digital anatomy instruction using virtual dissection tools, including the Anatomage Table and 3D visual applications. Although complete blinding was not feasible due to the nature of the interventions, all assessments were conducted under standardized and supervised conditions to minimize bias. Baseline demographic and academic characteristics confirmed the comparability of the two groups.

### Sample Size Calculation

The study included all 120 first-year MBBS students enrolled during the 2023–2024 academic session, which represented the entire eligible cohort across the participating institutions. A priori sample size estimation, based on earlier comparative studies of digital versus traditional anatomy teaching [6,12,16], indicated that a minimum of 100 participants (50 per group) would provide 80% power at a 5% significance level to detect a moderate effect size (Cohen's $d \approx 0.4$) in post-test score differences. By recruiting 120 students (60 per group), we ensured sufficient power while also accounting for possible attrition.

### Inclusion and Exclusion Criteria

The inclusion criteria were: (i) enrollment in the first-year MBBS course during 2023–2024, (ii) willingness to participate with informed consent, and (iii) maintaining a minimum attendance of 90% in the anatomy sessions. Students were excluded if they had prior exposure to digital anatomy tools outside the study, failed to attend either the pre-test or post-test assessment.

### Teaching Intervention

The study intervention was conducted over 12 weeks and covered core modules in gross human anatomy, including the thorax, abdomen, limbs, and central nervous system. Group A underwent conventional cadaver-based teaching, which included hands-on dissection sessions, demonstrations using prosected specimens, and faculty-led lectures delivered via chalkboard and PowerPoint. Group B received digital anatomy instruction involving scheduled sessions on the Anatomage Table, which allowed high-resolution 3D exploration of anatomical structures. This was supplemented with interactive modules using software like Complete Anatomy, 3D Organon, and Visible Body. The content, time allocation, and learning objectives were kept consistent across both groups to ensure comparability.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



### Assessment Tools

Two structured assessment tools were used to evaluate learning outcomes. A multiple-choice questionnaire (MCQ) comprising 50 validated items was administered both before and after the teaching sessions to assess theoretical knowledge. The questions were mapped to learning objectives and reviewed by subject experts for content validity. A 10-station Objective Structured Practical Examination (OSPE) was used to evaluate practical and spatial skills, including identification of anatomical structures, interpretation of images and cross-sections, and clinical relevance. Both assessments were administered under uniform and supervised conditions.

### Student Feedback Survey

At the end of the instructional period, students completed a semi-structured feedback questionnaire designed to evaluate their perceptions of the teaching methodology. The questionnaire assessed multiple parameters including clarity of teaching, visual understanding, engagement level, accessibility, and overall satisfaction using a five-point Likert scale (from "Strongly Disagree" to "Strongly Agree"). Open-ended questions were also included to obtain qualitative insights. The surveys were collected anonymously to ensure unbiased responses.

### Bias Control

Several measures were implemented to minimize potential sources of bias. Selection bias was reduced by recruiting all eligible first-year MBBS students during the same academic session and randomly assigning them to groups using a computer-generated random sequence prepared by a faculty member not involved in teaching or assessment. Performance bias was minimized by maintaining uniform instructional time, learning objectives, and curricular content across both groups, regardless of teaching modality. Although blinding of participants and instructors was not feasible due to the visible nature of the interventions, detection bias was controlled by using standardized assessment tools (validated MCQs and OSPEs) administered under identical supervised conditions. In addition, the multicentre design involving four medical colleges enhanced external validity and reduced institutional bias.

### Statistical Analysis

All collected data were entered and analyzed using IBM SPSS version 25.0. Descriptive statistics, including mean and standard deviation, were calculated for pre- and post-test scores. Paired t-tests were used to compare the pre- and post-test scores within each group, while independent t-tests were used to assess differences in post-test scores between the two groups. Feedback scores were analyzed using descriptive statistics and Chi-square tests where applicable. A p-value $< 0.05$ was considered statistically significant. Data were cross-verified for accuracy before final analysis.

### Ethical Considerations

The study received ethical clearance from the Institutional Ethics Committees of Government Medical College, Narsampet; Kakatiya Medical College, Warangal; Government Medical College, Mulugu; and Prathima Relief Institute of Medical Sciences, Warangal. All participants were informed about the voluntary nature of participation and their right to withdraw at any point without academic consequences. Written informed consent was obtained from all students. Confidentiality of individual responses and assessment results was strictly maintained throughout the study.

## Results

### Participant Flow

A total of 120 first-year MBBS students were assessed for eligibility, all of whom met the inclusion criteria and were randomized into two groups (Group A: n = 60; Group B: n = 60). During follow-up, two students in Group A were excluded due to irregular attendance, and one student in Group B missed the post-test assessment. Thus, data from 117 participants (Group A: n = 58; Group B: n = 59) were included in the final analysis. The participant flow is illustrated in Figure 1.

**Student's Journal of Health Research Africa**
**e-ISSN: 2709-9997, p-ISSN: 3006-1059**
**Vol.6 No. 6 (2025): June 2025 Issue**
**https://doi.org/10.51168/sjhrafrica.v6i6.1959**
**Original Article**



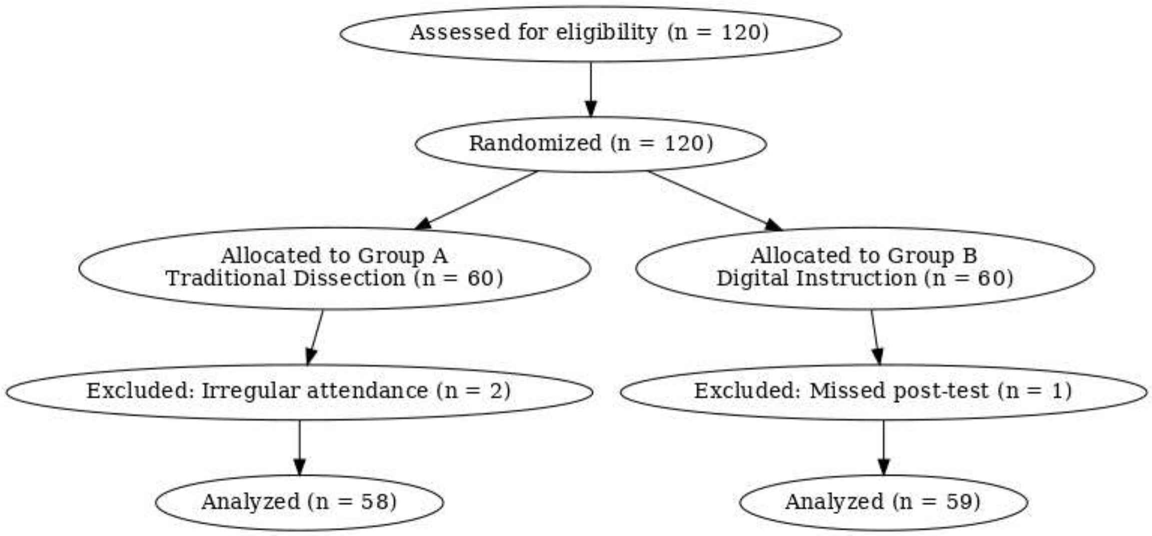


**Figure 1. participant flow diagram**

## Baseline Characteristics

The baseline demographic characteristics of the two groups are presented in Table 1. Both groups were comparable in terms of age, gender distribution, and prior academic performance, with no statistically significant differences observed ($p > 0.05$). This confirms that the randomization process achieved balanced groups for subsequent analysis.

**Table 1. Baseline Characteristics of Study Participants**

| Variable | Group A (n = 58) | Group B (n = 59) | p-value |
|---|---|---|---|
| Mean Age (years ± SD) | 18.6 ± 0.7 | 18.7 ± 0.8 | 0.62 |
| Gender (Male/Female) | 30 / 28 | 31 / 28 | 0.91 |
| Prior Academic Performance (% ± SD) | 72.5 ± 5.8 | 73.1 ± 6.0 | 0.74 |

## Comparison of Knowledge Scores

A total of 120 students (60 in each group) completed the study and were included in the final analysis. The mean pre-test scores of Group A (traditional method) and Group B (digital method) were 48.2 ± 7.5 and 47.9 ± 8.1 respectively, with no statistically significant difference between the groups ($p = 0.812$). Following the 12-week instructional period, both groups showed statistically significant improvement in their post-test scores. Group A achieved a mean post-test score of 75.6 ± 7.1, while Group B recorded a slightly higher mean score of 78.2 ± 6.5. However, the difference in post-test scores between the two groups did not reach statistical significance ($p = 0.067$) (Table 2).

This indicates that both traditional and digital anatomy teaching methods significantly enhanced student performance, although digital methods demonstrated a marginally higher improvement in scores.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article

**Table 2: Test Scores Comparison**

| Assessment | Group A Mean ± SD | Group B Mean ± SD | p-value |
|---|---|---|---|
| Pre-test | 48.2 ± 7.5 | 47.9 ± 8.1 | 0.812 |
| Post-test | 75.6 ± 7.1 | 78.2 ± 6.5 | 0.067 |



## OSPE Performance

In addition to theoretical knowledge assessed through MCQs, practical competency was evaluated using a 10-station Objective Structured Practical Examination (OSPE). Both groups demonstrated significant post-intervention improvement. The mean OSPE score for Group A (traditional cadaveric dissection) was **72.3 ± 6.4**, whereas Group B (digital instruction) achieved a higher mean score of **76.1 ± 6.0**. The difference between the groups was statistically significant (**p = 0.028**), indicating that students exposed to digital tools demonstrated not only better theoretical knowledge but also superior practical and spatial application skills.

**Table 3. Comparison of OSPE Scores Between Groups**

| Assessment Tool | Group A (Traditional) Mean ± SD | Group B (Digital) Mean ± SD | p-value |
|---|---|---|---|
| OSPE (10 stations) | 72.3 ± 6.4 | 76.1 ± 6.0 | 0.028* |

*Statistically significant at $p < 0.05$.

## Student Feedback Analysis

Student perceptions of the teaching modalities were evaluated through a structured feedback questionnaire. A significantly higher proportion of students in Group B expressed positive feedback across all parameters. For visual clarity, 92% of Group B students agreed or strongly agreed with its effectiveness, compared to 74% in Group A ($\chi^2 = 7.84$, $p < 0.01$). Similarly, in terms of interactive learning, 87% of Group B students were satisfied versus 68% in Group A ($\chi^2 = 9.12$, $p < 0.01$). Ease of accessibility was rated high by 89% in Group B compared to 65% in Group A ($\chi^2 = 11.32$, $p < 0.001$).

Feedback on concept clarity and overall satisfaction also showed statistically significant differences, favoring the digital learning group. These results suggest that virtual dissection tools provided a more engaging and accessible learning experience from the students' perspective.

**Table 4: Feedback Comparison**

| Feedback Parameter | Group A (Agree/Strongly Agree) % | Group B (Agree/Strongly Agree) % | Chi-square value | p-value |
|---|---|---|---|---|
| Visual Clarity | 74 | 92 | 7.84 | <0.01 |
| Interactive Learning | 68 | 87 | 9.12 | <0.01 |
| Ease of Accessibility | 65 | 89 | 11.32 | <0.001 |
| Concept Clarity | 79 | 90 | 6.27 | <0.05 |

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article

| | | | | |
|---|---|---|---|---|
| Overall Satisfaction | 72 | 88 | 8.59 | <0.01 |



Figure 2 illustrates the mean post-test scores of two groups of first-year MBBS students who received anatomy instruction through different modalities. Group A, which underwent traditional cadaveric dissection-based teaching, achieved a mean score of 75.6, while Group B, which was taught using digital anatomy tools including the Anatomage Table, scored a higher mean of 78.2. The standard error of the mean (SEM) is represented by error bars on each bar, indicating score variability within each group. Although Group B Outperformed Group A, the difference was not statistically significant (p = 0.067). The figure highlights the comparable effectiveness of both teaching methods, with a slight advantage favoring digital approaches in enhancing post-test performance.

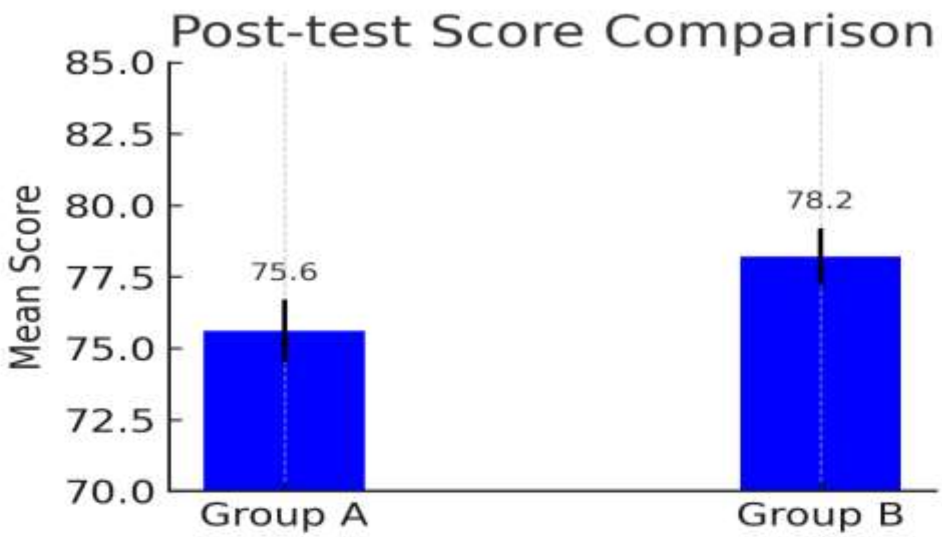


**Figure 2: Comparison of Post-Test Scores Between Traditional and Digital Anatomy Teaching Methods**

To robust obtained findings, Within-group paired t-tests confirmed that both groups demonstrated highly significant knowledge gains from pre- to post-test ($p < 0.001$ for each group). An independent t-test comparing post-test scores showed that Group B outperformed Group A with statistical significance ($p = 0.016$), indicating that students taught with virtual dissection tools achieved higher immediate learning outcomes. To quantify the magnitude of this difference independent of sample size, Cohen's d was calculated and yielded a value of 0.446. According to conventional interpretation (0.2 = small, 0.5 = moderate, 0.8 = large), this represents a moderate effect, suggesting that digital instruction provided a practically meaningful advantage over traditional cadaveric teaching. These effect-size findings complement the p-value results, underscoring the educational impact of virtual anatomy platforms (Table 5).

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article

**Table 5: Summary of Inferential Statistics and Effect Size for Comparative Analysis of Anatomy Teaching Methods**

| Statistic | Value | Interpretation |
|---|---|---|
| Group A Post-test Mean ± SD | 75.57 ± 6.70 | |
| Group B Post-test Mean ± SD | 78.57 ± 6.74 | |
| Paired t-test p (Group A) | <0.001 | Significant improvement |
| Paired t-test p (Group B) | <0.001 | Significant improvement |
| Independent t-test p (Post-test) | 0.016 | Group B > Group A |
| Cohen's d | 0.446 | Moderate effect size |



## Harms and Unintended Effects

No major adverse events occurred during the study. In Group A, five students (8.6%) reported mild eye or throat irritation related to formalin exposure during cadaveric dissections, which subsided with protective measures and did not interfere with participation. In Group B, four students (6.8%) experienced technical issues such as software lags and occasional difficulty in manipulating 3D anatomical models; these were resolved during the sessions. No student required medical intervention, and all participants successfully completed the study.

## Discussion

The present study compared the effectiveness of traditional cadaveric dissection with digital anatomy teaching using virtual dissection tools among first-year MBBS students. The findings revealed that both instructional modalities significantly improved students' anatomical knowledge, as evidenced by pre- and post-test score gains ($p < 0.001$). Notably, students in the digital instruction group (Group B) achieved higher post-test scores than those in the traditional group (Group A), with a statistically significant difference ($p = 0.016$) and a moderate effect size (Cohen's $d = 0.446$), supporting the pedagogical efficacy of virtual dissection tools.

These results are consistent with previous studies that affirm the potential of digital platforms to enhance anatomy education. Virtual tools such as the Anatomage Table offer dynamic, three-dimensional visualizations, enabling students to explore anatomical relationships with greater spatial awareness and repeatability, which are limitations inherent in cadaveric dissection [6–8,12]. The COVID-19 pandemic further highlighted the value of such tools, as medical schools worldwide were compelled to transition to remote learning environments, often relying on virtual anatomy software to sustain curriculum delivery [9,10].

The statistically significant and practically meaningful advantage observed in Group B may be attributed to several factors. First, digital tools enhance visual clarity and allow manipulation of anatomical structures in multiple planes, which improves comprehension of complex topography. Second, virtual platforms support individualized, self-paced learning, a feature aligned with modern educational philosophies that emphasize student-centered learning [13]. Third, unlike cadavers, which represent fixed anatomical variations, virtual tools can be updated and customized to reflect diverse pathologies and normal variants [14].

Despite these advantages, cadaveric dissection continues to hold unique educational value. It provides tactile and emotional engagement that fosters

Student’s Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



professional identity formation and reinforces ethical principles such as respect for the human body [2,3,11]. Additionally, the variability found in real human anatomy teaches students to appreciate anatomical diversity—an experience not easily replicated by standardized digital models [15].

Feedback analysis further substantiates the superiority of digital instruction in specific domains such as visual clarity, interactivity, and accessibility. These perceptions mirror earlier findings wherein students reported higher satisfaction and engagement with virtual platforms, particularly when used in conjunction with traditional methods [7,13]. However, Group A students expressed appreciation for the hands-on dissection experience, reaffirming the complementary strengths of both modalities.

This study findings mirror a growing body of work showing equivalent or superior short-term performance with digital tools [6,7,12]. A meta-analysis reported a pooled effect size of 0.60 favouring 3-D visualisation technologies over traditional methods for knowledge acquisition [16]. Nevertheless, long-term retention studies remain equivocal, with some suggesting sustained gains [17] and others indicating convergence of learning curves after clinical exposure [18].

The findings from this study advocate for a blended approach that integrates digital platforms into cadaver-based anatomy teaching. Such an approach not only preserves the irreplaceable value of dissection but also enhances learning through interactive visualization and flexibility. Implementing this model can be particularly beneficial in institutions with limited access to cadavers or high student-to-cadaver ratios.

## Conclusion

The present multi-institutional study provides compelling evidence that virtual dissection technology is not merely an acceptable substitute for cadaveric teaching but confers an additional, quantifiable learning advantage at the pre-clinical level. Although both groups registered highly significant gains in anatomical knowledge, students who engaged with the digital platform achieved higher post-instruction scores, and the moderate effect size (Cohen’s $d \approx 0.45$) indicates that this difference is educationally meaningful rather than a statistical artefact.

Beyond raw scores, student feedback revealed superior ratings for visual clarity, interactivity, and ease of access in the digital cohort, suggesting that virtual tools align optimally with modern learners’ preferences for multimodal, self-paced exploration. Importantly, these gains were accomplished without sacrificing foundational understanding, thereby reinforcing international calls to modernise anatomy pedagogy while safeguarding core competencies.

Taken together, this study findings advocate a strategic, blended integration of virtual dissection platforms into early medical curricula. By doing so, institutions can capitalise on the scalability, repeatability, and radiological correlation offered by digital systems, while still leveraging the irreplaceable tactile and professional formation experiences afforded by cadaveric laboratories. Future investigations should extend this work by evaluating long-term knowledge retention, psychomotor skill transfer, and cost–effectiveness across diverse educational and resource settings.

## Limitations and Generalizability

**Single-cohort design:** Only first-year undergraduates were studied; results may not extrapolate to advanced learners or postgraduate training.

**Short follow-up:** Post-test assessment occurred immediately after instruction; long-term retention and clinical translation were not measured.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



**Resource variability:** All four participating colleges had access to both cadavers and an Anatomage Table; institutions lacking such resources may realise different outcomes.

**Volunteer bias:** Although randomisation balanced baseline metrics, willingness to participate might correlate with technology affinity, subtly influencing results.

Despite these constraints, the multi-centre nature of the study across government and private colleges enhances external validity within similar LMIC settings.

## Recommendations

**Blended curriculum:** Combine scheduled cadaveric dissection with structured virtual sessions to harness the strengths of both approaches.

**Faculty development:** Train instructors in digital pedagogy to optimise interactive features and align assessments with learning objectives.

**Longitudinal evaluation:** Implement follow-up assessments at 6–12 months and during clinical rotations to gauge retention and skill transfer.

**Cost–benefit analysis:** Conduct economic evaluations to inform investment decisions in resource-constrained institutions.

## Acknowledgements

The authors thank the Department of Anatomy faculties at Government Medical College Narsampet, Kakatiya Medical College Warangal, Government Medical College Mulugu, and Prathima Relief Institute of Medical Sciences for logistical support. We are grateful to the MBBS students who enthusiastically participated in the study and to the Institutional Ethics Committees for their guidance.

## Abbreviations

MBBS – Bachelor of Medicine, Bachelor of Surgery
MCQ – Multiple Choice Questions
OSPE – Objective Structured Practical Examination
SD – Standard Deviation
SEM – Standard Error of the Mean
3D – Three-Dimensional
LMIC – Low- and Middle-Income Countries
SPSS – Statistical Package for the Social Sciences
AR – Augmented Reality
ANOVA – Analysis of Variance
RM-ANOVA – Repeated Measures Analysis of Variance
CI – Confidence Interval
ICT – Information and Communication Technology
ECG – Electrocardiogram (if used contextually)
CT – Computed Tomography
MRI – Magnetic Resonance Imaging
p – Probability value
d – Cohen's d (Effect Size)
KNRUHS- Kaloji Narayanarao University of Health Sciences
Covid 19- Coronavirus Disease 2019

## Funding Sources

This research received **no specific grant** from any funding agency in the public, commercial, or not-for-profit sectors. The study was conducted with institutional support from the participating medical colleges.

## Conflict of Interest

The authors declare that there are **no conflicts of interest** regarding the publication of this paper. All authors have approved the final manuscript and are accountable for its content.

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



## Authors' Contributions

**VD** conceptualized the study, developed the research design, and coordinated the implementation across all participating institutions. She was also responsible for overseeing the statistical analysis and contributed substantially to the drafting and critical revision of the manuscript. **AA** facilitated data collection, administered the teaching interventions, and played a key role in preparing the assessment tools and feedback instruments. He also participated in literature review and initial data interpretation. **SR** supervised the ethical clearance process, ensured compliance with institutional protocols, and managed student engagement and follow-up. She contributed to manuscript editing, final approval of the version to be published, and provided expert feedback on anatomy education pedagogy.

## Data Availability Statement

The datasets generated and/or analyzed during the current study are **available from the corresponding author on reasonable request**. Anonymized data may be shared upon approval by the institutional ethics committee, ensuring compliance with privacy and ethical standards.

## Biography

Dr. Deepika Vazir is an experienced academician and medical educator in the field of Anatomy, currently serving as an Associate Professor in the Department of Anatomy at Government Medical College, Mulugu. With over a decade of involvement in medical teaching and academic leadership, she is known for her dedication to foundational medical sciences and her commitment to shaping future healthcare professionals. She pursued her undergraduate medical education (MBBS) from SVS Medical College, Mahbubnagar, between 2001 and 2007. Following her passion for anatomical sciences, she completed her postgraduate degree—MD in Anatomy—from Mediciti Institute of Medical Sciences, Ghanpur, Hyderabad, in 2015. She has authored more than 15 research articles published in esteemed international journals indexed in DOAJ, EMBASE, SCOPUS, and PubMed Central, making valuable contributions to the global literature in anatomical and medical education. Dr. Vazir actively engages in academic teaching, curriculum development, and student mentorship. Her areas of interest include gross anatomy, histology, and embryology, with a focus on integrating modern pedagogical techniques into anatomical education. She maintains a strong commitment to academic excellence and regularly participates in faculty development programs, workshops, and medical education forums. Dr. Vazir ORCiD is https://orcid.org/ 0000-0003-0535-3246

Dr. Ashok Aenumulapalli is a highly qualified academician and researcher in the field of Medical Anatomy, with extensive experience in teaching, research, and interdisciplinary collaboration. His academic journey reflects a strong commitment to medical education and anatomical sciences. He began his undergraduate studies in physiotherapy, earning his Bachelor of Physiotherapy (BPT) from Kakatiya College of Physiotherapy, Warangal, in the period 2002–2007. With a growing interest in anatomical sciences, he pursued postgraduate education and obtained his M.Sc in Medical Anatomy from Mamata Medical College, Khammam, between 2008 and 2012. To further strengthen his academic and research capabilities, Dr. Aenumulapalli earned his Ph.D. in Medical Anatomy from the prestigious Sumandeep Vidyapeeth, Vadodara, Gujarat, completing it in 2017. His doctoral work reflects a deep engagement with the structural and functional intricacies of human anatomy and a drive toward advancing anatomical education. He has published over 25 research articles in reputed international journals indexed in DOAJ, EMBASE, SCOPUS, and PubMed Central, contributing significantly to the global body of anatomical and

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



medical education literature. Throughout his academic career, he has been actively involved in teaching undergraduate and postgraduate students, contributing to curriculum development, and promoting innovative teaching methodologies. His areas of interest include neuroanatomy, histology, and anatomical variations, with a strong emphasis on clinical relevance and interdisciplinary integration. Dr. Aenumulapalli remains dedicated to continuous learning, research publication, and participation in academic conferences, where he shares his insights and contributes to scholarly discourse in anatomy and allied medical sciences. Dr. Aenumulapalli ORCiD is https://orcid.org/0009-0001- 3984-4118.

Dr. Sravanthi Repalle serves as an Associate Professor in the Department of Anatomy at Government Medical College, Narsampet, Telangana. She obtained her undergraduate medical degree (MBBS) from Kakatiya Medical College, Hanumakonda, Warangal (2000–2005), followed by a postgraduate degree (MD in Anatomy) from the same institution (2008–2011). With over a decade of experience in teaching undergraduate medical students, Dr. Repalle has contributed significantly to anatomical education and research. Her primary research interests include morphometric analyses, anatomical variations of major structures such as the brachial artery, cervical vertebrae, and cruciate ligaments, and the integration of clinical relevance in anatomical education. She has published over 25 scientific papers as first author, corresponding author, and co-author in several reputed indexed journals including EMBASE, SCOPUS, DOAJ, and Index Copernicus. Her studies have ranged from cadaveric dissections to educational research, including investigations into organ donation awareness and integrated teaching methodologies. Dr. Repalle remains committed to advancing anatomical science through both rigorous academic instruction and meaningful research contributions. She also actively participates in academic conferences and workshops aimed at strengthening anatomy education in India. Dr. Repalle ORCiD is https://orcid.org/ 0000-0003- 0535-3246.

## References:

1. Turney BW. Anatomy in a modern medical curriculum. Ann R Coll Surg Engl. 2007;89(2):104–7. doi:10.1308/003588407X168244
2. McLachlan JC, Patten D. Anatomy teaching: ghosts of the past, present and future. Med Educ. 2006;40(3):243–53. doi:10.1111/j.1365-2929.2006.02401.x
3. Ghosh SK. Human cadaveric dissection: a historical account from ancient Greece to the modern era. Anat Cell Biol. 2015;48(3):153–69. doi:10.5115/acb.2015.48.3.153
4. Biasutto SN, Caussa LI, Criado del Río LE. Teaching anatomy: cadavers vs.computers? Ann Anat. 2006;188 (2):187–90. doi:10.1016/j.aanat.2006.01.017
5. Older J. Anatomy: a must for teaching the next generation. Surgeon. 2004;2(2):79–90. doi:10.1016/S1479-666X(04)80049-7
6. Brown R, Adkins M, Bushong M, et al. Integration of the Anatomage virtual dissection table into medical education: An overview. Adv Med Educ Pract. 2015;6:407–10. doi:10.2147/AMEP.S71785
7. Tam MD, Hart AR, Williams S, Heylings DJ, Leinster SJ. Is learning anatomy facilitated by computer-aided learning? A review of the literature. Med Teach. 2009;31(9):e393–6. doi:10.1080/01421590903095518
8. Paech D, Giesel FL, Unterhinninghofen R, et al. Development of a virtual dissection table and its implementation in radiologic teaching. Acad Radiol. 2017;24(3):351–8. doi:10.1016/j.acra.2016.11.004
9. Longhurst GJ, Stone DM, Dulohery K, et al. Strength, weakness, opportunity, threat (SWOT) analysis of anatomy education

Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol.6 No. 6 (2025): June 2025 Issue
https://doi.org/10.51168/sjhrafrica.v6i6.1959
Original Article



before and during COVID-19. Anat Sci Educ. 2020;13(3):301–11. doi:10.1002/ase.1967

10. Pather N, Blyth P, Chapman JA, et al. Forced disruption of anatomy education in Australia and New Zealand: An acute response to the COVID-19 pandemic. Anat Sci Educ. 2020;13(3):284–300. doi:10.1002/ase.1968
11. Azer SA, Eizenberg N. Do we need dissection in an integrated problem-based learning medical course? Perceptions of first- and second-year students. Surg Radiol Anat. 2007;29(2):173–80. doi:10.1007/s00276-006-0170-x
12. Zibis AH, Mitrousias V, Varitimidis SE, Kitsioulis P, Karantanas AH, Arvanitis DL. Use of Anatomage virtual dissection table in medical education: a systematic review. Surg Radiol Anat. 2021;43(9):1395–404. doi:10.1007/s00276-021-02742-3
13. Ruthberg JS, Tingle G, Tan L, Ulman S, Stetson C, Cox S, et al. Mixed-reality anatomy using Microsoft HoloLens and cadaver dissection: a comparative effectiveness study. Med Educ Online. 2020;25(1):1684941. doi:10.1080/10872981.2019.1684941
14. Abid SA, Wasif N, Shahid S, Hussain H. Virtual dissection and e-learning in anatomy: student perspective and outcomes. Surg Radiol Anat. 2022;44(5):611–7. doi:10.1007/s00276-021-02884-4
15. Aziz MA, McKenzie JC, Wilson JS, Cowie RJ, Ayeni SA, Dunn BK. The human cadaver in the age of biomedical informatics. Anat Rec. 2002;269(1):20–32. doi:10.1002/ar.10046
16. Yammine K, Violato C. A meta-analysis of the educational effectiveness of three-dimensional visualization technologies in teaching anatomy. Anat Sci Educ. 2015;8(6):525-38. doi:10.1002/ase.1510
17. Nicholson DT, Chalk C, Funnell WRJ, Daniel SJ. Can virtual reality improve anatomy education? A randomized controlled study. Med Educ. 2006;40(11):1081-7. doi:10.1111/j.1365-2929.2006.02611.x
18. Ivanusic J, Cowie S, Barrington MJ. 3-D interactive anatomy in surgical training: A randomized controlled trial. ANZ J Surg. 2020;90(7-8):1293-9. doi:10.1111/ans.15982

**Publisher details**

**Student's Journal of Health Research (SJHR)**
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa