

EDUCATION

Can Cadaviz Effectively Enhance My Learning of Human Anatomy? Perspectives From First-Year MBBS Students

G. Durga Devi¹  | P. R. Devaki² | Jinu Merlin Koshy¹ | R. Rahe¹ | R. Archana¹

¹Department of Anatomy, Sree Balaji Medical College and Hospital, BIHER University, Chennai, Tamil Nadu, India | ²Department of Physiology, Sree Balaji Medical College and Hospital, BIHER University, Chennai, Tamil Nadu, India

Correspondence: G. Durga Devi (departmentofmedicalresearch6@gmail.com)

Received: 25 February 2026 | **Revised:** 11 April 2026 | **Accepted:** 19 April 2026

Keywords: anatomy learning | Cadaviz | first-year MBBS | medical education | student perception | virtual dissection

ABSTRACT

Virtual dissection tables such as Cadaviz offer interactive, 3D visualization of anatomical structures, potentially enhancing comprehension and engagement in medical education. This study examines how first-year MBBS students with diverse academic standings perceive the effectiveness of Cadaviz in supporting their anatomy learning. A cross-sectional survey was conducted with 220 first-year MBBS students at Sree Balaji Medical College, Chennai. Participants were stratified into Below-Average, Average, and Above-Average groups based on internal assessment scores. Perceptions of Cadaviz were assessed using a 20-question Likert-scale questionnaire covering effectiveness, engagement, interactivity, accessibility, usability, and perceived role of Cadaviz alongside traditional dissection. Data were analyzed descriptively and via one-way ANOVA to compare mean Likert Scale Scores across performance strata. Cadaviz was perceived as an effective anatomy learning tool, with below-average students reporting the greatest benefits in understanding structures, comprehension, and learning efficiency ($p = 0.043\text{--}0.005$). While traditional cadaveric dissection remained preferred, Cadaviz was valued as a supplement, enhancing engagement, interactivity, and self-paced learning. Students highlighted its accessibility, flexibility, and user-friendly interface, with fewer technical difficulties. Cadaviz fostered inclusive, learner-centered education, promoting active participation, conceptual understanding, and confidence across all academic strata, particularly supporting students needing additional reinforcement.

1 | Introduction

Contemporary medical academia is confronted with a dual imperative. Students must be prepared to navigate increasingly complex, technology-driven healthcare environments, mastering not only foundational biomedical knowledge but also clinical reasoning, decision-making, and interprofessional skills. At the same time, educators must accommodate diverse learning styles, integrate innovative pedagogical strategies, and adapt to the rapid evolution of medical curricula, assessment methods, and competency-based frameworks. Meeting these parallel demands underscores the need for advanced, learner-centered digital approaches that effectively bridge theoretical knowledge and practical application (Chowdhury et al. 2024). In the field of

anatomy, where hands-on understanding is critical, these challenges and opportunities are particularly pronounced.

Anatomy is the cornerstone of medical education. A thorough understanding of the human body is essential for effective medical practice (Abdellatif et al. 2022). While cadaveric dissection provides invaluable firsthand insight into the three-dimensional organization, spatial relationships, and anatomical variations of tissues and organs, the practice is inherently limited (Brenner et al. 2025). Traditional practical sessions involving the dissection of a human cadaver are constrained by time, availability of specimens, and logistical challenges (Coker et al. 2024). They are typically conducted in groups. This limits opportunities for repeated practice,

individualized exploration, and active participation for all students. Furthermore, this format also fails to accommodate the diverse learning pace and preferences within a cohort, leaving learners with visual, auditory, kinesthetic, or other learning requirements at a potential disadvantage (MacPherson and Lisk 2022).

Accordingly, a greater emphasis is placed on the active use of supplementary digital tools in medical education (Al-Rubaie 2025). In this context, virtual dissection tables (VDTs), such as Cadaviz, have emerged as valuable adjuncts to traditional dissection methods. They enable 360° exploration of human anatomy, with the ability to zoom in on structures, thereby enhancing spatial understanding and improving retention of complex anatomical relationships (Starszak et al. 2025). By integrating gross anatomy with radiology, physiology, embryology, histology, and other disciplines, Cadaviz helps students gain a comprehensive understanding of the human body. High-resolution imaging, combined with intuitive touch-based interfaces, not only supports dynamic exploration of the virtual human body but also, through customizable layering, enables users to isolate organs, trace neural pathways, and examine systems with clarity (Bokil et al. 2025).

The pedagogical value of VDTs extends well beyond visualization. They actively promote experiential and self-directed learning by allowing students to engage in iterative exploration, reinforce concepts through repeated virtual dissections, and receive immediate feedback on spatial and functional relationships (Boscolo-Berto et al. 2021). Additionally, VDTs facilitate collaborative learning, enabling groups to study the same virtual specimen, discuss anatomical nuances, and integrate clinical correlations in real time. By combining these features, VDTs provide a dynamic, interactive, and learner-centered approach to anatomy education (Evans et al. 2024).

In the era of competency-based education, VDTs bridge the gap between theoretical knowledge and practical understanding, enhancing cognitive retention while accommodating diverse learning styles. They provide early exposure to complex anatomical concepts and help develop digital literacy, preparing students for a technologically advanced clinical environment (Arráez-Aybar 2025; Wickramasinghe et al. 2022).

Given their expanding role in anatomy education, evaluating VDTs requires a broader perspective that extends beyond traditional objective assessments. Student experiences offer valuable insights into how these tools influence engagement, comprehension, and skill development (Al-Hor et al. 2024). Although several studies have explored perceptions of VDTs in general (Telecan et al. 2025), evidence specifically assessing the potential of Cadaviz remains limited. Consequently, the present study seeks to explore students' perceptions of Cadaviz. Additionally, the study compares perception across academic performance levels. For academic performance as a key variable in evaluating perception. Learners with different performance levels often vary in prior knowledge, cognitive processing, and learning strategies, which can influence how they engage with and benefit from immersive educational tools (Persky et al. 2020). Therefore, stratifying students into below average, average, and above average groups

is essential to examine whether CADAVIZ is equally effective and accessible across diverse learner profiles. This approach directly aligns with the study objective by enabling a more comprehensive evaluation of immersive learning, ensuring that its perceived value is not limited to a specific subset of students. An educational tool that demonstrates consistent benefit across all performance strata can be considered inclusive, robust, and pedagogically effective. This perspective is particularly relevant for first-year MBBS students, who are adapting to foundational concepts and new learning approaches. Differences in academic achievement may also influence engagement with digital tools (Sangam et al. 2024). Understanding these variations is crucial to ensuring meaningful learning for all students and to guiding the development of inclusive, competency-driven instructional strategies (Baptiste and Abramovich 2024).

Building on this rationale, the present study examines how first-year MBBS students perceive the VDT Cadaviz in anatomy learning. By comparing perceptions across performance-based groups, the study aims to provide deeper insight into its effectiveness in supporting understanding, engagement, and skill development across learners with varying academic abilities.

2 | Methods

2.1 | Study Design and Setting

A cross-sectional study was conducted among first-year MBBS students of the 2024–2025 batch at Sree Balaji Medical College and Hospital, Chennai. The study was conducted after obtaining approval from the Institutional Ethics Committee (Ref. No. 002/SBMCH/IHEC/2025/2389).

2.2 | Sample Size and Stratification Strategy

A total of 220 students were included using universal sampling, wherein all eligible first-year MBBS students who consented to participate were enrolled. This approach ensured comprehensive representation of the study population without selection bias. To enable a structured comparison across the diverse spectrum of academic performances, participants were stratified based on their previous five formative assessment scores (out of 70) from the regular anatomy curriculum. These scores represented a composite of internal assessments, including theory examinations, practical assessments, and viva voce conducted during the ongoing academic term, rather than a single test. Based on these cumulative scores, students were stratified into three groups, namely: below average (< 35), average (35–50), and above average (51–70). The details of the stratification are presented in Table 1. This stratification enabled subgroup analysis of perception across different academic performance levels.

2.3 | Questionnaire

The study employed a validated, structured questionnaire consisting of 20 closed-ended questions. Responses were rated on a

five-point Likert scale (1 = *strongly disagree*, 5 = *strongly agree*) to capture students' perceptions of Cadaviz. The questionnaire assessed factors such as effectiveness, engagement and interactivity, accessibility, technical usability, learning outcomes, and perceived role of Cadaviz alongside traditional dissection (Table 2). This categorization ensured adequate representation of each construct while maintaining conceptual clarity. The

domain categorization was guided by established educational frameworks, including constructivist learning theory and models of technology-enhanced learning, and was aligned with prior literature on virtual dissection tools and digital learning environments. Content validity was established through expert review by three senior faculty members in anatomy and medical education, who evaluated the items for relevance, clarity, and domain alignment. A pilot study conducted among a subset of students ($n=20$) further helped refine the questionnaire by improving wording and eliminating ambiguity (Sangam et al. 2024).

TABLE 1 | Stratification of study participants based on internal assessment performance.

S. No.	Categories	Internal assessment marks	Sample size ($n=220$)
1.	Below average	< 35	84
2.	Average	35–50	93
3.	Above average	51–70	43

2.4 | Data Collection and Data Analysis

Data were collected using Google Forms and subsequently analyzed using IBM SPSS Statistics version 21.0. Descriptive statistics were employed to summarize the data, with categorical variables presented as frequencies and percentages, and continuous variables reported as mean \pm standard deviation (SD). For comparison of continuous variables across the three academic performance groups, one-way analysis of variance (ANOVA)

TABLE 2 | Domain-wise distribution of questionnaire items with individual questions.

Domain	Question item
Effectiveness in learning anatomy	Cadaviz effectively helps me understand anatomical structures
	Cadaviz improves my overall comprehension of human anatomy
	I can learn anatomical structures more efficiently with the help of Cadaviz
Perceived role of Cadaviz alongside traditional dissection	I feel that Cadaviz enhances my three-dimensional understanding of the human body
	Virtual dissection is as effective as traditional dissection
	I prefer virtual dissection over traditional dissection
Engagement and interactivity	Cadaviz is an excellent supplement to traditional dissection
	Cadaviz is engaging and holds my attention better
	I find the interactive features of Cadaviz helpful
Accessibility and learning flexibility	The use of Cadaviz keeps me actively involved in the lesson
	I believe that the 3D interactivity of Cadaviz enhances engagement
	Cadaviz is easily accessible whenever I need to
Technical usability and confidence	I find it easier to access Cadaviz tools as compared to other resources
	Cadaviz allows me to learn at my own pace, unlike traditional dissection
	Cadaviz is more accessible for review
	Cadaviz helps overcome the limitations of time and the availability of specimens
	I find Cadaviz easy to use and navigate
	I encounter fewer technical difficulties with Cadaviz
	I prefer Cadaviz because of its user-friendly and intuitive interface
	I feel confident using Cadaviz for my studies

was performed after verifying the assumption of normality. $p < 0.05$ was considered statistically significant.

In addition, to assess the magnitude of differences between groups, effect size was calculated using Cohen's d for pairwise comparisons between below-average and above-average students. Cohen's d values were interpreted as small (0.2), moderate (0.5), and large (0.8), providing insight into the practical significance of the observed differences.

Responses from 220 first-year medical students were analyzed to understand their perceptions of Cadaviz across different aspects such as effectiveness, engagement and interactivity, accessibility, usability, and its role alongside traditional cadaveric dissection. Table 3 shows the detailed distribution of responses for each question, including frequencies and percentages, giving an overall picture of how students rated the tool.

To explore how these perceptions varied with academic performance, mean Likert scores were calculated for below average, average, and above average groups. These trends are presented in Figure 1, which also highlights statistically significant differences between the groups.

In addition to statistical significance, effect size analysis was carried out to understand how meaningful these differences were. Table 4 presents the effect sizes for each item along with their interpretation. Taken together, the table and figure help provide a clear understanding of how students with different academic performance levels perceive Cadaviz in anatomy learning.

2.5 | Effectiveness in Learning Anatomy

Students generally perceived Cadaviz as an effective tool for understanding anatomical structures. For the statement "Cadaviz effectively helps me understand anatomical structures," the mean scores were 4.0 (below average), 3.61 (average), and 3.7 (above average), with a statistically significant difference ($*p = 0.043$). "Cadaviz improves my overall comprehension of human anatomy" scored 3.79, 3.35, and 3.26 ($*p = 0.014$). "I can learn anatomical structures more efficiently with the help of Cadaviz" had mean scores of 3.88, 3.6, and 3.3 ($*p = 0.047$). "I feel that Cadaviz enhances my three-dimensional understanding of the human body" scored 3.51, 2.99, and 2.88 ($**p = 0.005$).

The statistically significant differences (p values ranging from 0.043 to 0.005) indicate that students' perceptions of Cadaviz varied meaningfully according to their academic performance. Below-average students consistently reported higher mean scores than average and above-average students, suggesting that even learners with lower prior academic performance can engage more effectively with Cadaviz and improve their understanding of the human anatomy.

As shown in Table 4, these findings are supported by small-moderate to moderate effect sizes, indicating a meaningful educational impact, particularly among below-average learners.

2.6 | Perceived Role of Cadaviz Alongside Traditional Dissection

Responses regarding traditional cadaveric dissection were more varied. For "Virtual dissection is as effective as traditional dissection," the mean scores were 3.64 (below average), 3.02 (average), and 3.0 (above average) with a statistically significant difference ($**p = 0.002$), indicating meaningful variation in perceptions across academic groups. Only 29% of students expressed a preference for virtual dissection ("I prefer virtual dissection over traditional dissection"; 3.27, 2.4, 2.37; $**p < 0.001$), showing that cadaveric dissection remains the preferred method for most students.

However, for "Cadaviz is an excellent supplement to traditional dissection," the mean scores were 3.76 (below average), 3.08 (average), and 3.09 (above average) with a statistically significant difference ($**p = 0.001$). This indicates that students, particularly those with lower prior academic performance, engage more actively and participate more effectively when Cadaviz is used alongside traditional dissection, reinforcing that while virtual dissection cannot fully replace cadaveric dissection, it serves as a valuable adjunct, promoting engagement, comprehension, and accessibility, particularly for students who benefit from additional reinforcement.

As reflected in Table 4, moderate to large effect sizes highlight meaningful differences in perception, particularly among below-average students.

2.7 | Engagement and Interactivity

Students rated Cadaviz positively for engagement and interactive features. "Cadaviz is engaging and holds my attention better" had mean scores of 3.44 (below average), 2.87 (average), and 3.07 (above average), with a statistically significant difference ($*p = 0.022$), indicating that Cadaviz may particularly help students who might otherwise struggle to maintain attention during lessons. Similarly, "I find the interactive features of Cadaviz helpful" scored 3.76 (below average), 3.26 (average), and 3.65 (above average) ($*p = 0.014$), suggesting that the visual and hands-on interactive elements of Cadaviz were especially beneficial for learners with lower prior academic performance.

"The use of Cadaviz keeps me actively involved in the lesson" received mean Likert scores as 3.68 for below average, 3.28 for average, and 3.7 for above average; $p = 0.062$ (ns) and "I believe that the 3D interactivity of Cadaviz enhances engagement" received mean Likert scores 3.71 for below average, 3.51 for average, and 3.77 for above average; $p = 0.303$ (ns) showed no significant differences across academic groups, indicating that all students valued the immersive and participatory aspects of Cadaviz. Together, these features help transform students from passive recipients into engaged learners, improving understanding, retention, motivation, and practical application of knowledge. Overall, the results suggest that Cadaviz promotes active learning, particularly supporting students who require additional reinforcement while simultaneously providing an engaging experience for all learners.

TABLE 3 | Student perceptions toward Cadaviz in learning anatomy.

S. No.	Question	<i>Strongly disagree</i>	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>	<i>Strongly agree</i>
1.	Cadaviz effectively helps me understand anatomical structures.	11 (5%)	5 (2.27%)	71 (32.27%)	68 (30.91%)	65 (29.55%)
2.	Virtual dissection is as effective as traditional dissection.	24 (10.91%)	40 (18.18%)	56 (25.45%)	56 (25.45%)	44 (20%)
3.	Cadaviz improves my overall comprehension of human anatomy.	17 (7.73%)	21 (9.55%)	64 (29.09%)	71 (32.27%)	47 (21.36%)
4.	I can learn anatomical structures more efficiently with the help of Cadaviz.	14 (6.36%)	34 (15.45%)	44 (20%)	51 (23.18%)	77 (35%)
5.	I feel that Cadaviz enhances my three-dimensional understanding of the human body.	28 (12.73%)	31 (14.09%)	76 (34.55%)	46 (20.91%)	39 (17.73%)
6.	Cadaviz is engaging and holds my attention better.	37 (16.82%)	35 (15.91%)	62 (28.18%)	35 (15.91%)	51 (23.18%)
7.	I find the interactive features of Cadaviz helpful.	17 (7.73%)	22 (10%)	64 (29.09%)	62 (28.18%)	55 (25%)
8.	The use of Cadaviz keeps me actively involved in the lesson.	17 (7.73%)	34 (15.45%)	50 (22.73%)	57 (25.91%)	62 (28.18%)
9.	I prefer virtual dissection over traditional dissection.	68 (30.91%)	29 (13.18%)	59 (26.82%)	23 (10.45%)	41 (18.64%)
10.	I believe that the 3D interactivity of Cadaviz enhances engagement.	11 (5%)	25 (11.36%)	47 (21.36%)	87 (39.55%)	50 (22.73%)
11.	Cadaviz is easily accessible whenever I need to.	16 (7.27%)	23 (10.45%)	64 (29.09%)	45 (20.45%)	72 (32.73%)
12.	I find it easier to access Cadaviz tools as compared to other resources.	19 (8.64%)	56 (25.45%)	58 (26.36%)	45 (20.45%)	42 (19.09%)
13.	Cadaviz allows me to learn at my own pace, unlike traditional dissection.	19 (8.64%)	30 (13.64%)	67 (30.45%)	53 (24.09%)	51 (23.18%)
14.	I feel that Cadaviz is more accessible for review.	21 (9.55%)	37 (16.82%)	61 (27.73%)	42 (19.09%)	59 (26.82%)
15.	Cadaviz helps overcome the limitations of time and the availability of specimens.	18 (8.18%)	34 (15.45%)	59 (26.82%)	55 (25%)	54 (24.55%)
16.	I find Cadaviz easy to use and navigate.	7 (3.18%)	39 (17.73%)	50 (22.73%)	71 (32.27%)	53 (24.09%)
17.	Cadaviz is an excellent supplement to traditional dissection.	22 (10%)	40 (18.18%)	56 (25.45%)	45 (20.45%)	57 (25.91%)
18.	I feel confident using Cadaviz for my studies.	30 (13.64%)	29 (13.18%)	62 (28.18%)	47 (21.36%)	52 (23.64%)
19.	I encounter fewer technical difficulties with Cadaviz.	29 (13.18%)	35 (15.91%)	59 (26.82%)	52 (23.64%)	45 (20.45%)
20.	I prefer Cadaviz because of its user-friendly and intuitive interface.	34 (15.45%)	32 (14.55%)	55 (25%)	57 (25.91%)	42 (19.09%)

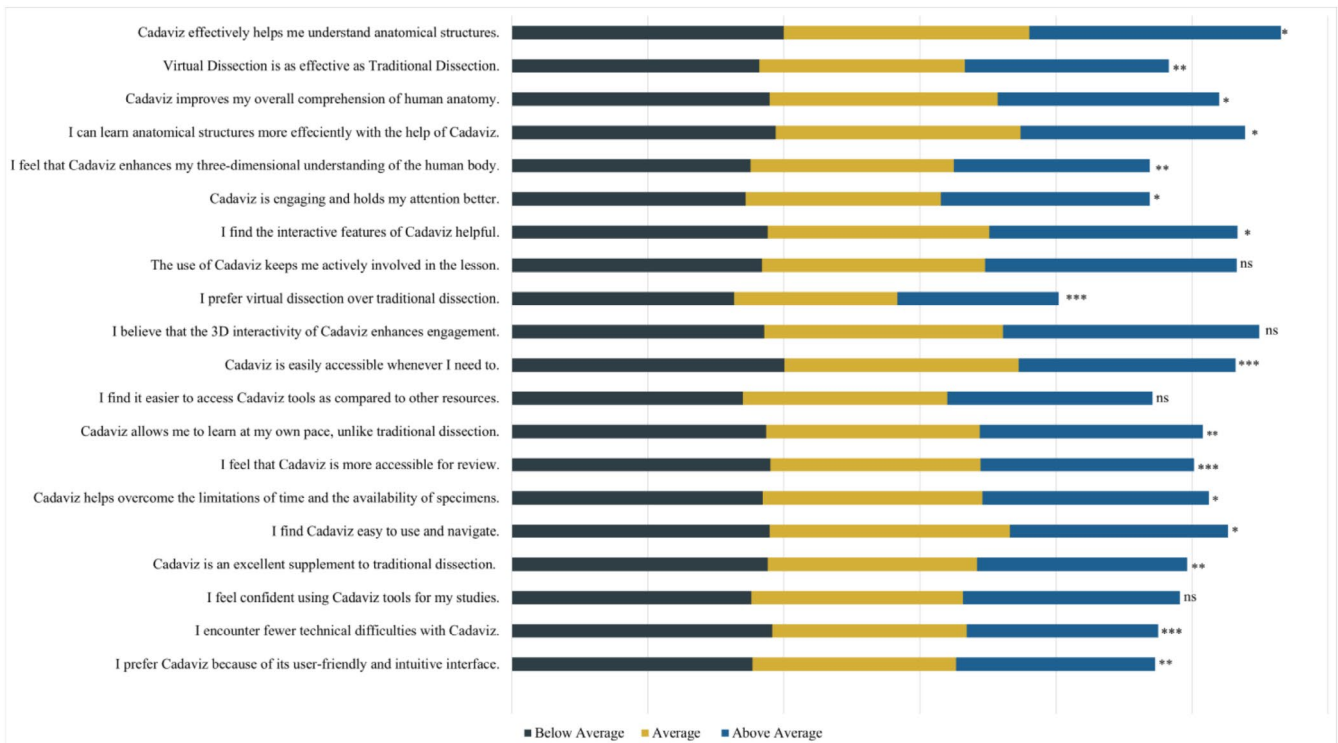


FIGURE 1 | Visual representation of the comparative mean Likert scores of student perceptions toward Cadaviz across three academic performance groups. Statistical differences across groups are indicated: * $p < 0.05$, ** $p < 0.01$, and nonsignificant (ns, $p \geq 0.05$).

As shown in Table 4, moderate effect sizes for key engagement items, along with small effects for nonsignificant findings, indicate that while Cadaviz enhances engagement overall, its impact is more pronounced among below-average learners.

2.8 | Accessibility and Learning Flexibility

Accessibility was also highlighted as an advantage. “Cadaviz is easily accessible whenever I need to” scored 4.01 (below average), 3.44 (average), and 3.19 (above average) with a statistically significant difference (** $p < 0.001$), with 53.18% of students agreeing or strongly agreeing. The significant p value indicates that the differences in perception between academic groups are unlikely due to chance, suggesting that below-average students particularly benefit from the convenience of Cadaviz access. “I find it easier to access Cadaviz tools as compared to other resources” scored 3.4, 3.0, and 3.02 ($p = 0.07$, ns), with 39.54% agreement, showing no significant difference across academic groups and indicating that all students found Cadaviz comparably convenient.

“Cadaviz allows me to learn at my own pace, unlike traditional dissection” scored 3.74, 3.14, and 3.28 (** $p = 0.004$), with 47.27% agreement, demonstrating that self-paced learning is particularly valued by students with lower prior academic performance. “I feel that Cadaviz is more accessible for review” scored 3.8, 3.09, and 3.14 (** $p < 0.001$), with 45.91% agreement, and “Cadaviz helps overcome the limitations of time and the availability of specimens” scored 3.69, 3.23, and 3.33 (* $p = 0.038$), with 49.55% agreement. These significant differences indicate that Cadaviz provides tangible benefits in

flexibility and access, particularly for students who may need additional reinforcement, while nonsignificant results suggest that certain features are valued equally across all academic performance groups.

As indicated in Table 4, large and moderate effect sizes emphasize that accessibility and flexibility are key strengths of Cadaviz, particularly benefiting below-average students.

2.9 | Technical Usability and Confidence

Students generally found Cadaviz easy to use. “I find Cadaviz easy to use and navigate” scored 3.79 (below average), 3.53 (average), and 3.21 (above average) with a statistically significant difference (* $p = 0.022$), indicating that below-average students found it particularly approachable. “I encounter fewer technical difficulties with Cadaviz” scored 3.83, 2.86, and 2.81 (** $p < 0.001$), and “I prefer Cadaviz because of its user-friendly and intuitive interface” scored 3.54, 2.99, and 2.93 (** $p = 0.008$), highlighting that even below-average students found Cadaviz especially user-friendly. In contrast, “I feel confident using Cadaviz for my studies” scored 3.52, 3.11, and 3.19 ($p = 0.099$, ns), indicating no significant differences across academic groups and showing that Cadaviz is a learner-centric inclusive tool that is favorable for all learners regardless of the academic strata and hence has the potential to reduce learning disparities by enhancing conceptual understanding and engagement even among academically weaker learners.

As shown in Table 4, moderate to large effect sizes in usability-related items highlight that Cadaviz is particularly user-friendly

TABLE 4 | Cohen's *d* effect size analysis highlighting differences in Cadaviz perception between below-average and above-average learners.

S. No.	Question	Cohen's <i>d</i>	Interpretation
1.	I prefer Cadaviz because of its user-friendly and intuitive interface.	0.5	Moderate effect indicating that below-average students perceive Cadaviz as more user-friendly, supporting improved usability for below average performers.
2.	I encounter fewer technical difficulties with Cadaviz	0.71	Large effect indicating substantially fewer perceived technical barriers among below-average students, enhancing accessibility
3.	I feel confident using Cadaviz tools for my studies	0.31	Small effect with no significant difference, suggesting similar confidence levels across academic groups
4.	The technology behind Cadaviz works smoothly with	0.62	Moderate effect indicating smoother perceived functionality among below-average students
5.	I find Cadaviz software easy to use and navigate	0.43	Moderate effect suggesting better usability perception among below-average students
6.	Cadaviz helps overcome limitations of time and availability	0.39	Small-moderate effect indicating that Cadaviz helps address learning constraints, particularly for lower-performing students
7.	I feel that Cadaviz is more accessible for review	0.71	Large effect demonstrating strong perceived benefit of Cadaviz for revision among below-average students
8.	Cadaviz allows me to learn at my own pace unlike	0.55	Moderate effect indicating that self-paced learning is particularly beneficial for below-average students
9.	I find it easier to access Cadaviz tools compared to	0.34	Small effect with no significant difference, suggesting comparable accessibility across groups
10.	Cadaviz is easily accessible whenever I need to	0.71	Large effect showing that below-average students benefit more from flexible access
11.	I believe that the 3D interactivity of Cadaviz enhances	0.19	Small effect with no significant difference, indicating uniform appreciation across all learners
12.	I prefer Cadaviz over traditional dissection due to	0.71	Large effect indicating stronger preference among below-average students, though overall preference remains limited
13.	The use of Cadaviz keeps me actively involved in	0.35	Small effect with no significant difference, suggesting similar engagement across groups
14.	I find the interactive features of Cadaviz to be	0.46	Moderate effect indicating enhanced benefit of interactivity for below-average students
15.	Cadaviz is engaging and holds my attention better	0.43	Moderate effect suggesting improved engagement particularly among lower-performing students
16.	I feel that Cadaviz provides a more in-depth understanding	0.54	Moderate effect indicating improved spatial understanding, especially for below-average students
17.	I can learn anatomical structures more effectively with the help of Cadaviz	0.37	Small-moderate effect suggesting improved learning efficiency among below-average students
18.	Cadaviz improves my overall comprehension of human anatomy.	0.46	Moderate effect indicating better conceptual understanding among below-average students
19.	Cadaviz is as effective as traditional dissection.	0.58	Moderate effect reflecting differing perceptions across groups, with cautious acceptance of virtual tools
20.	Cadaviz effectively helps me understand anatomical structures and their spatial relationships.	0.38	Small-moderate effect indicating improved anatomical understanding, particularly among below-average students

and supportive for below-average learners, while confidence levels remain comparable across groups.

3 | Discussion

Virtual dissection technologies have emerged as transformative adjunct tools in medical education, offering immersive and interactive support to traditional anatomy learning (Estai and Bunt 2016). In the present study, the use of Cadaviz as a virtual dissection platform demonstrated significant potential in enhancing students' understanding, engagement, and accessibility in anatomy learning, particularly among participants with below-average academic performance. The findings reveal that while traditional cadaveric dissection remains indispensable, the integration of virtual tools such as Cadaviz provides a powerful complement that reinforces comprehension and inclusivity in medical education. The findings of our study are consistent with the results reported by García-Robles et al. (2024), who emphasized that immersive virtual anatomy platforms effectively complement traditional cadaveric learning by deepening spatial understanding, improving engagement, and supporting diverse learning preferences without replacing hands-on dissection.

In the current study, it was observed that students in general perceived Cadaviz as an effective means of understanding anatomical structures. However, statistically significant differences across the three groups revealed that below-average students resonated particularly well with the interactive and immersive features of the VDT. Thus, indicating that Cadaviz may serve as an equalizing educational tool, bridging performance gaps by enabling students to visualize complex anatomical relationships at their own pace. The ability to manipulate 3D models, isolate structures, and repeatedly review content may have contributed to the increase in comprehension and retention among learners who might otherwise struggle with traditional methods of learning anatomy.

Similar trends were observed in the work of Elbeshbeishy et al. (2025), supporting the findings of our study. Their research explored the perceptions of medical and allied health students toward cadaveric dissection and virtual resources in anatomy education. The study found that digital tools, including virtual dissection platforms, were particularly beneficial for students who faced challenges with traditional dissection methods. By offering an interactive and accessible means to engage with anatomical content, digital tools have been shown to improve learning outcomes across performance levels (Elbeshbeishy et al. 2025). Consistent with this observation, we found that by offering a flexible and interactive learning environment, Cadaviz creates an active learning space for all strata of students.

A study by Ralte et al. (2023) reported that 96% of students agreed that virtual dissection complements traditional learning, with 100% participants favoring a blended approach. Similarly, in the current study, students strongly agreed that Cadaviz is an effective supplement to cadaveric dissection and should be used in conjunction with it for maximum benefits. This finding is also supported by Funjan et al. (2023) who found that more than 80%

students expressed a preference for learning anatomy using both digital and as well as traditional resources, rather than using any single resource exclusively.

Thus, the findings of the current study, together with existing research, highlight the growing consensus in favor of adopting a blended approach to anatomy education, integrating tactile realism and emotional engagement of cadaveric dissection (Verma and Sharma 2025), with the accessibility, interactivity, and limitless practice afforded by virtual tools (Deng et al. 2022).

Alasmari (2021) found that over 70% of students believe VDTs enhance active engagement during practical sessions. From our own observations, it was revealed that the interactive and 3D immersive features of Cadaviz are especially valued for enhancing student engagement across all academic levels. While all strata of participants believed that with Cadaviz, learning is an active and participatory process, the below-average students, who might otherwise struggle to keep up with conventional pedagogy, professed increased engagement. According to Sultana et al. (2022), the ability to explore anatomical structures independently through immersive 3D visualization likely fosters motivation and deeper cognitive involvement, which may have been the reason for the increase in comprehension with Cadaviz. Overall, these findings suggest that interactivity and immersivity are key features of Cadaviz that benefit all learners, regardless of their academic standing.

The findings of our study are also supported by several studies on VDTs, which similarly highlight increased motivation and engagement through interactive, immersive, and self-directed learning experiences. For example, Yoon (2025) demonstrated that 3D virtual cadaver dissection significantly improves autonomous learning motivation and academic performance among medical students, suggesting that VDTs can particularly support those who find conventional methods challenging. Likewise, Aboregela et al. (2024) reported that virtual dissection applications enhanced engagement and accommodated diverse learning needs among medical students in Saudi Arabia and Egypt. Additionally, Koney et al. (2024) found that students at the University of Ghana considered virtual dissection both engaging and effective for visualizing complex anatomical structures.

Furthermore, the current study also highlighted that the accessibility and flexibility offered by Cadaviz are especially valued by the students for promoting self-paced learning and review, with below-average learners demonstrating the strongest agreement. Mirroring the observations of our study, Shine et al. (2025) reported that virtual dissection effectively accommodates diverse learning styles and allows individualized reinforcement of complex topics.

Lastly, in the current study, students also reported that the intuitive interface of Cadaviz is easy to access, navigate, and use. Emphasizing the potential of Cadaviz as an effective, inclusive, complementary, and student-centered educational resource for learning anatomy for all students, irrespective of their academic standing.

3.1 | Educational Implications

The findings of this study underscore the practical value of integrating virtual dissection platforms like Cadaviz into anatomy education. By supplementing traditional cadaveric dissection, Cadaviz provides self-paced, interactive, and immersive learning, offering below-average students the opportunity to reinforce understanding and bridge gaps in spatial and conceptual knowledge. Its features foster active engagement, motivation, and deeper comprehension, allowing repeated practice without limitations on lab hours or specimen availability. The preference for a blended learning approach highlights the importance of combining digital and hands-on methods, ensuring equitable learning opportunities, enhancing overall outcomes, and preparing students for technology-driven healthcare environments.

3.2 | Limitations and Future Directions

The present study is based on self-reported perceptions, which may not directly reflect measurable improvements in academic performance or skill acquisition. Future studies should incorporate objective assessments of learning outcomes, such as pre- and post-intervention tests or performance evaluations in anatomy examinations. Additionally, longitudinal research could explore the long-term impact of virtual dissection on retention, spatial reasoning, and clinical application. Comparative studies involving other digital anatomy platforms could further validate the unique advantages and pedagogical potential of Cadaviz.

4 | Conclusion

In conclusion, students perceive Cadaviz as an innovative and effective enhancement to anatomy learning. It transforms complex anatomical concepts into clearer, more engaging experiences, particularly supporting those who find traditional methods challenging. From the students' perspective, Cadaviz not only complements cadaveric dissection but also fosters confidence, inclusivity, and autonomy in learning. These perceptions collectively affirm that integrating virtual dissection tools like Cadaviz can enrich anatomy education and better prepare learners for technology-driven medical training environments.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

References

Abdellatif, H., M. AlMushaiqri, H. Albalushi, A. A. Al-Zaabi, S. Roychoudhury, and S. Das. 2022. "Teaching, Learning, and Assessing Anatomy With Artificial Intelligence: The Road to a Better Future." *International Journal of Environmental Research and Public Health* 19: 14209. <https://doi.org/10.3390/ijerph192114209>.

Aboregela, A. M., Z. Khired, S. E. Osman, et al. 2024. "Virtual Dissection Applications in Learning Human Anatomy: International Medical Students' Perspectives." *BMC Medical Education* 24, no. 1: 1259. <https://doi.org/10.1186/s12909-024-06218-z>.

Alasmari, W. A. 2021. "Medical Students' Feedback on Applying the Virtual Dissection Table (Anatomage) in Learning Anatomy: A Cross-Sectional Descriptive Study." *Advances in Medical Education and Practice* 12: 1303–1307. <https://doi.org/10.2147/AMEP.S324520>.

Al-Hor, M., H. Almahdi, M. Al-Theyab, A. G. Mustafa, M. Seed Ahmed, and S. Zaout. 2024. "Exploring Student Perceptions on Virtual Reality in Anatomy Education: Insights on Enjoyment, Effectiveness, and Preferences." *BMC Medical Education* 24, no. 1: 1–9. <https://doi.org/10.1186/s12909-024-06370-6>.

Al-Rubaie, A. 2025. "From Cadavers to Codes: The Evolution of Anatomy Education Through Digital Technologies." *Medical Science Educator* 35, no. 2: 1101–1109. <https://doi.org/10.1007/s40670-024-02268-6>.

Arráez-Aybar, L. A. 2025. "Evolving Anatomy Education: Bridging Dissection, Traditional Methods, and Technological Innovation for Clinical Excellence." *Anatomia* 4, no. 2: 9. <https://doi.org/10.3390/anatomia4020009>.

Baptiste, Y. M., and S. Abramovich. 2024. "Community College Student Perceptions of Digital Anatomy Models as a Curricular Resource." *Anatomical Sciences Education* 17, no. 9: 1731–1748. <https://doi.org/10.1002/ase.2523>.

Bokil, P., A. Relekar, R. Nandy, R. D. Nishanth, P. Yadav, and D. Das. 2025. "Advancing Medical Education: Exploring Virtual Dissection Tables and Skill Labs for Innovative Visualisation and Simulation Techniques." *Cent India J Med Res* 4, no. 1: 24–28. <https://doi.org/10.58999/cijmr.v4i01.203>.

Boscolo-Berto, R., C. Tortorella, A. Porzionato, et al. 2021. "The Additional Role of Virtual to Traditional Dissection in Teaching Anatomy: A Randomised Controlled Trial." *Surgical and Radiologic Anatomy* 43, no. 4: 469–479. <https://doi.org/10.1007/s00276-020-02551-2>.

Brenner, E., E. Pechriggl, and M. Konschake. 2025. "The Human Cadaver as an Educational Tool: Classification and Comparison With Other Educational Tools." In *International Anatomical Education. Biomedical Visualization*, eds. I. D. Keenan, I. Stabile, and A. Venkatesh, 17–41. Springer. https://doi.org/10.1007/978-3-031-91849-0_2.

Chowdhury, P. N., A. Vaish, B. Puri, and R. Vaishya. 2024. "Medical Education Technology: Past, Present, and Future." *Apollo Medicine* 21: 374–380. <https://doi.org/10.1177/09760016241256202>.

Coker, C., R. S. Rogers, B. Freed, et al. 2024. "Battle of the Sections: Student Outcomes and Course Feedback Support Combined Prosection and Dissection Laboratory Formats to Maximise Student Success." *Anatomical Sciences Education* 17: 1012–1025. <https://doi.org/10.1002/ase.2420>.

Deng, Q. F., H. Chu, B. Peng, X. Liu, and Y. S. Cao. 2022. "Localised Xanthogranulomatous Pyelonephritis in Children: A Case Report and Literature Review." *Frontiers in Pediatrics* 10: 952989. <https://doi.org/10.3389/fped.2022.952989>.

Elbeshbeishy, R., R. Salama, B. M. Goud, et al. 2025. "Unveiling the Perceptions of Medical and Allied Health Students Towards Cadaveric Dissection and Virtual Resources in Anatomy Education: A Cross-Sectional Study." *BMC Medical Education* 25, no. 1: 829. <https://doi.org/10.1186/s12909-025-07432-z>.

Estai, M., and S. Bunt. 2016. "Best Teaching Practices in Anatomy Education: A Critical Review." *Annals of Anatomy* 208: 151–157. <https://doi.org/10.1016/j.aanat.2016.02.010>.

Evans, L., L. Singer, D. Zahra, I. Agbeja, and S. M. Moyes. 2024. "Optimising Group Work Strategies in Virtual Dissection." *Anatomical Sciences Education* 17, no. 6: 1323–1335. <https://doi.org/10.1002/ase.2473>.

Funjan, K., L. Ashour, M. Salameh, A. Mustafa, and A. M. Seed. 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* 14: 837–844.

García-Robles, P., I. Cortés-Pérez, F. A. Nieto-Escámez, H. García-López, E. Obrero-Gaitán, and M. C. Osuna-Pérez. 2024. “Immersive Virtual Reality and Augmented Reality in Anatomy Education: A Systematic Review and Meta-Analysis.” *Anatomical Sciences Education* 17, no. 3: 514–528. <https://doi.org/10.1002/ase.2397>.

Koney, N. K., A. O. Ansah, B. N. Asaku, et al. 2024. “Anatomage Virtual Dissection Versus Traditional Human Body Dissection in Anatomy Pedagogy: Insights From Ghanaian Medical Students.” *BMC Medical Education* 24, no. 1: 1059. <https://doi.org/10.1186/s12909-024-06029-2>.

MacPherson, E., and K. Lisk. 2022. “The Value of In-Person Undergraduate Dissection in Anatomical Education in the Time of COVID-19.” *Anatomical Sciences Education* 15: 797–802. <https://doi.org/10.1002/ase.2186>.

Persky, A. M., E. Lee, and L. S. Schlesselman. 2020. “Perception of Learning Versus Performance as Outcome Measures of Educational Research.” *American Journal of Pharmaceutical Education* 84, no. 7: ajpe7782. <https://doi.org/10.5688/ajpe7782>.

Ralte, S., A. Bhattacharyya, A. D. Momin, and S. P. Sundaram. 2023. “Perceived Effectiveness of Cadaveric and Three-Dimensional Virtual Dissection in Learning Anatomy Among First-Year MBBS Students: A Cross-Sectional Study From Northeastern India.” *National Journal of Clinical Anatomy* 12, no. 3: 157–164.

Sangam, M. R., R. Deka, A. Kaur, and M. Wahengbam. 2024. “Perception of First-Year MBBS Students Toward Virtual Dissection in Learning Anatomy: A Comparative Study Between High and Low Academic Achievers.” *Cureus* 16, no. 10: e72508. <https://doi.org/10.7759/cureus.72508>.

Shine, S., J. Warznie, G. Zhou, and J. Zubek. 2025. “From Virtual to Reality: Evaluating Student Attitudes Through VR Dissection Preparations: A Use Case.” *Advances in Physiology Education* 49, no. 3: 611–620. <https://doi.org/10.1152/advan.00170.2024>.

Starszak, K., R. Karaś, A. Skalski, K. Czarnecka-Chrebelska, T. Lepich, and G. Bajor. 2025. “Advances in Anatomy Education: The Role of Virtual Anatomy Tables, Immersive Techniques, and 3D Printing—A Systematic Review.” *Folia Morphologica* 84: 104410. <https://doi.org/10.5603/fm.104410>.

Sultana, Q., R. Jain, M. H. Shariff, P. Quadras, and A. Ramos. 2022. “The Impact of a Simulation-Based Teaching Module Involving Virtual Dissection on Anatomy Curriculum Delivery.” *International Journal of Anatomy and Research* 10: 8476–8481. <https://doi.org/10.16965/ijar.2022.219>.

Telecan, T., R. D. Capraş, G. A. Filip, M. Bonea, and C. B. Crivii. 2025. “Dissection in the 21st Century: Virtual Tables Versus Traditional Methods and Their Influence on Medical Students’ Perception—A Systematic Review.” *BMC Medical Education* 25, no. 1: 1332. <https://doi.org/10.1186/s12909-025-07946-6>.

Verma, S., and U. Sharma. 2025. “Alternatives to Cadaveric Dissection in Medical Education: An Overview.” *International Journal of Advanced Medical and Health Research* 12, no. 1: 12–22. https://doi.org/10.4103/ijamr.ijamr_316_24.

Wickramasinghe, N., B. R. Thompson, and J. Xiao. 2022. “The Opportunities and Challenges of Digital Anatomy for Medical Sciences: Narrative Review.” *JMIR Medical Education* 8, no. 2: e34687. <https://doi.org/10.2196/34687>.

Yoon, H. 2025. “Effects of 3D Virtual Cadaver Practice on Learning Motivation, Academic Achievement, and Self-Efficacy Among First-Year Nursing Students.” *Nurse Education in Practice* 84: 104302. <https://doi.org/10.1016/j.nepr.2025.104302>.