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A study of perception of first year MBBS students towards virtual dissection in Anatomy teaching in a new medical college in Central India

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Abstract

Introduction: Anatomy is a fundamental component of undergraduate medical education; however, its extensive content and three-dimensional nature can make learning challenging for students. The increasing use of educational technology has led to the introduction of virtual anatomy dissection as an alternative or complementary teaching strategy. Virtual dissection enables students to explore and manipulate digital representations of anatomical structures using an interactive electronic platform. This study aims to assess the perceptions of first-year MBBS students regarding the usefulness of virtual anatomy dissection and to compare perceptions between students with higher and lower academic achievement.

Methodology: A cross-sectional study will be conducted among first-year MBBS students at a medical college in Central India following approval from the Institutional Ethics Committee. Data will be collected using a validated questionnaire administered electronically through Google Forms. The questionnaire will include closed-ended statements assessed using a five-point Likert scale, along with open-ended questions designed to explore students' experiences and perceptions of virtual anatomy dissection. The questionnaire will assess multiple domains, including perceived effectiveness of virtual dissection, student engagement and interactivity, accessibility, technical usability, learning outcomes, and its perceived role in relation to conventional cadaveric dissection. Appropriate statistical methods will be used to compare responses between students categorized as higher and lower academic achievers.

Expected Results: The study is expected to provide information regarding students' perceptions of virtual anatomy dissection as a learning tool. Particular attention will be given to its perceived contribution to understanding anatomical concepts, motivation, engagement, retention of knowledge, academic learning, and reduction of anxiety associated with anatomy learning. The study will also explore whether perceptions differ according to students' academic achievement and whether students consider virtual dissection an alternative to, or a supplementary tool alongside, traditional cadaveric dissection.

Conclusion: Virtual anatomy dissection has the potential to complement conventional anatomy teaching by providing students with an interactive and technology-assisted approach to understanding three-dimensional anatomical structures. Evaluation of student perceptions in a medical college setting in Central India may help determine its educational usefulness and identify its appropriate role within the undergraduate anatomy curriculum. The findings may support the development of a blended approach in which virtual resources supplement, rather than replace, cadaver-based learning.

Keywords: Anatomy education; educational technology; medical education; student perception; virtual anatomy dissection; undergraduate medical students.

Introduction

Cadaveric dissection has traditionally formed the foundation of anatomy education, providing students with direct tactile and three-dimensional exposure to human anatomical structures. However, the increasing volume of anatomical knowledge and the need for more engaging teaching strategies have encouraged medical educators to explore technology-assisted approaches. One such innovation is **virtual anatomy dissection**, which provides an interactive digital representation of the human body and allows students to explore anatomical structures through a computer-based or table-based interface.

Virtual dissection platforms enable learners to examine anatomical structures in three dimensions, selectively isolate individual structures, perform virtual dissections, reconstruct anatomical regions, and adjust the magnification to appreciate spatial relationships. Students can also revisit specific structures repeatedly and review previously studied regions according to their individual learning needs. Such flexibility may facilitate self-directed learning and allow students to progress at a pace appropriate to their level of understanding. Computer-based simulation resources can additionally provide extensive supplementary material and opportunities for repeated practice and revision.

Despite these potential advantages, the incorporation of virtual dissection into anatomy education remains a subject of discussion. Some learners may value the accessibility, flexibility, and interactive nature of virtual platforms, whereas others may perceive the absence of physical tissue handling and tactile feedback as an important limitation. Conventional cadaveric dissection provides experiences that may be difficult to reproduce completely in a digital environment, particularly with regard to tissue texture, anatomical variation, and hands-on manipulation.

Therefore, understanding students' perceptions is important when determining the appropriate role of virtual dissection within the anatomy curriculum. Evaluating students' experiences can help educators determine whether virtual resources should function as alternatives, complementary tools, or supplementary learning resources alongside conventional cadaveric teaching. Such an approach may facilitate the development of a balanced and learner-centered anatomy curriculum.

Objectives

The objectives of the present study are:

1. To assess the perceptions of first-year MBBS students regarding the use of virtual anatomy dissection for learning anatomy.
2. To compare the perceptions of high and low academic achievers regarding virtual anatomy dissection.

Materials And Methods

Study Design and Setting

A cross-sectional questionnaire-based study will be conducted among first-year MBBS students at a medical college in Central India, following approval from the Institutional Ethics Committee of the participating institution.

Development and Validation of the Questionnaire

A structured questionnaire will be developed by subject experts in anatomy to assess students' perceptions regarding virtual anatomy dissection. The questionnaire will cover major domains including the perceived effectiveness of virtual dissection, student engagement and interactivity, accessibility, technical usability, learning outcomes, and comparison with conventional cadaveric dissection.

Before the main study, the questionnaire will undergo pilot testing among a small group of students who will not be included in the final analysis. The pilot phase will assess the clarity and comprehensibility of the questions, identify ambiguous or difficult-to-understand items, evaluate the feasibility of the data-collection process, and allow appropriate modifications to the questionnaire before its final administration.

Data Collection

The finalized questionnaire will be administered electronically to first-year MBBS students. The questionnaire will consist of three sections. The first section will collect basic demographic information without personally identifying details. The second section will contain 20 closed-ended statements assessed using a five-point Likert scale ranging from strongly disagree to strongly agree. The third section will include 15 open-ended questions to obtain detailed qualitative information regarding students' experiences and perceptions of virtual anatomy dissection.

Before participation, students will be informed about the purpose and procedures of the study, confidentiality of the information provided, voluntary participation, and their right to withdraw from the study at any stage. Only students who provide informed consent will be permitted to complete the questionnaire.

Classification of Academic Achievement

Academic performance will be assessed using formative assessment scores obtained as part of the regular undergraduate anatomy curriculum during the relevant academic period. Students will be ranked according to their cumulative academic scores.

For comparison of perceptions, students from the upper and lower ends of the academic-performance distribution will be classified as high and low academic achievers, respectively. Students with intermediate scores will not be included in this comparative analysis, allowing a clearer comparison between the two academic-performance groups.

Quantitative Data Analysis

Responses to the five-point Likert scale will be coded numerically as follows:

Response	Score
Strongly disagree	1
Disagree	2
Neutral	3
Agree	4
Strongly agree	5

The quantitative responses will be summarized using frequencies, percentages, and mean scores. An independent-samples t-test will be used to compare the mean Likert scores between high and low academic achievers. A *p*-value of <0.05 will be considered statistically significant.

Qualitative Data Analysis

Responses to the open-ended questions will be analyzed using thematic analysis. The responses will be reviewed repeatedly to ensure familiarity with the data, after which meaningful statements relevant to students' perceptions of virtual anatomy dissection will be identified and coded. The qualitative responses will be organized into major thematic domains, including:

- Cognitive and learning impact
- Skill development
- Emotional response and learner engagement
- Technical usability and accessibility
- **Perceived advantages and limitations compared with conventional cadaveric dissection**

The coding and development of themes will be undertaken by subject experts, with the final themes representing the principal patterns identified within the students' responses.

Results

A total of 99 first-year MBBS students were invited to participate, of whom 89 students provided consent and completed the questionnaire**,** resulting in a response rate of 89.9%**.** Among the respondents, 16 (18.0%) were female and 73 (82.0%) were male**.**

Responses to the Likert-scale items were summarized using frequencies, percentages, and mean scores. The perceptions of students classified as high and low academic achievers were compared using an independent-samples t-test. Statistical significance was established at a p-value of <0.05**.**

Table 1. Perception of first-year MBBS students toward virtual dissection in anatomy learning

Responses are presented as frequency (percentage), except for mean Likert scores. Likert responses were coded as 1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, and 5 = strongly agree. Independent-samples t-test was used to compare mean scores between high and low academic achievers. A p-value <0.05 was considered statistically significant. Cohen's d was used as the measure of effect size, with 0.2, 0.5, and 0.8 representing small, medium, and large effects, respectively.

Sn.	Statement	Strongly disagree, n (%)	Disagree, n (%)	Neutral, n (%)	Agree, n (%)	Strongly agree, n (%)	Overall mean (N=89)	High achievers mean (n=30)	Low achievers mean (n=30)	t-value	p-value	Cohen's d
1	I enjoyed learning anatomy through virtual dissection.	4 (4.49)	8 (8.98)	24 (26.96)	38 (42.69)	15 (16.85)	3.58	4.30	2.80	6.447	<0.001*	1.60
2	Virtual dissection provides sufficient anatomical	18 (20.22)	30 (33.70)	19 (21.34)	17 (19.10)	5 (5.61)	2.56	2.80	2.40	1.287	0.101	0.30

	knowledge without the need for lectures.											
3	Virtual dissection improved my understanding of anatomy lectures.	0	5 (5.61)	19 (21.34)	49 (55.05)	16 (17.97)	3.85	4.13	3.70	2.137	0.018*	0.50
4	Virtual dissection motivates me to study anatomy and attend anatomy lectures.	3 (3.37)	8 (8.98)	23 (25.84)	40 (44.94)	15 (16.85)	3.62	4.03	3.40	2.692	0.004*	0.70
5	Virtual dissection makes anatomy learning a continuous process.	2 (2.24)	6 (6.74)	24 (26.96)	45 (50.56)	12 (13.48)	3.66	4.06	3.43	3.061	0.001*	0.70
6	Virtual dissection facilitates deeper learning of anatomy.	1 (1.12)	2 (2.24)	16 (17.97)	48 (53.93)	22 (24.71)	3.98	4.20	3.80	2.035	0.023*	0.50
7	Knowledge acquired through virtual dissection is more systematic.	0	7 (7.86)	30 (33.70)	35 (39.32)	17 (19.10)	3.69	3.76	3.53	0.985	0.164	0.20
8	Virtual dissection helped me memorize anatomical details more effectively.	0	3 (3.37)	14 (19.10)	39 (43.82)	33 (37.07)	4.14	4.26	4.10	0.813	0.209	0.10
9	Virtual dissection improved my performance in anatomy examinations.	1 (1.12)	4 (4.49)	21 (23.59)	45 (50.56)	18 (20.22)	3.84	4.03	3.73	1.352	0.090	0.30

10	Group-based virtual dissection in the laboratory is interesting and interactive.	2 (2.24)	3 (3.37)	14 (15.73)	52 (58.42)	18 (20.22)	3.91	4.10	3.93	0.889	0.188	0.20
11	Virtual dissection reduced my anxiety and made me more comfortable learning anatomy.	1 (1.12)	9 (10.11)	37 (41.57)	28 (31.46)	14 (15.73)	3.50	3.63	3.50	0.554	0.290	0.10
12	I prefer having an instructor guide me during virtual dissection.	0	6 (6.74)	12 (13.48)	44 (49.43)	27 (30.33)	4.03	4.06	4.00	0.290	0.386	0.10
13	I prefer having access to virtual dissection at any time for self-directed learning.	0	4 (4.49)	8 (8.98)	39 (43.82)	38 (42.69)	4.24	4.16	4.36	-0.920	0.180	0.20
14	I prefer learning anatomy through virtual dissection rather than cadaveric dissection.	31 (34.83)	18 (20.22)	20 (22.47)	14 (15.73)	6 (6.74)	2.39	2.33	2.40	-0.189	0.425	0.10
15	I found it difficult to locate and differentiate anatomical structures during virtual dissection.	9 (10.11)	22 (24.71)	35 (39.32)	18 (20.22)	5 (5.61)	2.86	3.23	2.50	3.094	0.001*	0.80
16	I avoid virtual dissection because I am apprehensive about using	31 (34.83)	16 (17.97)	20 (22.47)	17 (19.10)	5 (5.61)	2.42	2.40	2.26	0.395	0.347	0.10

	digital applications.											
17	I recommend using virtual dissection alone, without cadaveric dissection, for learning anatomy.	53 (59.55)	13 (14.60)	12 (13.48)	11 (12.35)	0	1.78	1.86	1.53	1.281	0.102	0.30
18	Virtual dissection should be used only as a supplement to cadaveric dissection.	3 (3.37)	2 (2.24)	17 (19.10)	30 (33.70)	37 (41.57)	4.07	3.96	4.26	-1.037	0.152	0.20
19	I would recommend virtual anatomy dissection to other students and for other courses.	2 (2.24)	8 (8.98)	18 (20.22)	41 (46.06)	20 (22.47)	3.77	3.86	3.76	0.385	0.350	0.10
20	The virtual dissection table is an essential resource for medical education.	1 (1.12)	5 (5.61)	24 (26.96)	38 (42.69)	21 (23.59)	3.82	3.93	3.60	1.350	0.091	0.30

Note: $p < 0.05$ indicates statistical significance.

Table 2. Perceptions of first-year MBBS students regarding virtual dissection in anatomy learning: responses to open-ended questions

Responses are presented as number (percentage) unless otherwise specified. Multiple responses were permitted for several questions; therefore, percentages may not total 100%.

Sn.	Open-ended question	Major themes / meaningful units, N = 89	Representative student comments
1	Had you used virtual dissection or similar digital anatomy resources before this study?	21 (23.59%) reported previous exposure to virtual dissection or comparable digital anatomy resources.	—
2	Approximately how much time did you spend each week studying anatomy using the virtual dissection table?	Mean weekly use was 3.76 ± 2.10 hours (range: 0–10 hours). High achievers: 4.62 ± 1.50 hours; low achievers: 2.24 ± 0.90 hours.	—

3	What factors would encourage you to use the virtual dissection table more frequently for self-study?	Greater realism: 68 (76.40%); accessibility: 66 (74.15%); interactivity: 60 (67.41%); convenience: 52 (58.42%).	"The virtual platform gives an experience that resembles actual dissection." "I can study according to my own pace and schedule."
4	What advantages does the virtual dissection table offer compared with resources such as videos, models, or anatomical atlases?	Interactive and immersive learning: 56 (62.92%).	"Unlike videos and static models, the virtual table allows active manipulation and exploration of anatomical structures in three dimensions." "Being able to interact with structures helped me understand their spatial relationships better."
5	How comfortable are you with using technology for learning?	65 (73.03%) reported being comfortable with educational technology, whereas 24 (26.96%) experienced some initial hesitation.	"At first, I found it difficult to understand the orientation, but with repeated use I became more comfortable and confident."
6	How would you describe the level of interactivity provided by virtual dissection?	69 (77.52%) expressed a favorable perception of the interactive component, particularly because active manipulation supported understanding and retention.	"The virtual table allows anatomical structures to be explored dynamically from different perspectives."
7	Do you consider virtual dissection an effective adjunct to conventional cadaveric dissection? Why or why not?	67 (75.28%) considered it an effective adjunct. Reported benefits included comprehensive exploration: 29 (32.58%); improved understanding: 25 (28.08%); greater engagement: 22 (24.71%); usefulness when cadavers are unavailable: 20 (22.47%); absence of health-related risks: 12 (13.48%). 66 (74.15%) felt that it could not replace cadaveric dissection because of lack of tactile experience: 42 (47.19%); limited realism and anatomical variability: 34 (38.20%); and reduced ethical/experiential learning: 18 (20.22%).	"It can be particularly useful when access to cadavers is limited." "The ability to rotate, isolate and examine structures in 3D makes anatomy more engaging." "The virtual model can be reset and explored repeatedly, which helps reinforce learning." "The tactile sensation and tissue characteristics experienced during cadaveric dissection cannot be reproduced digitally."
8	How can virtual dissection improve understanding of three-dimensional anatomy compared with conventional approaches?	Interactive learning: 56 (62.92%); repeatability: 50 (53.93%); detailed visualization: 42 (47.19%); flexible learning pace: 32 (35.95%); dynamic exploration: 12 (13.48%).	"Structures can be examined layer by layer and from different perspectives, providing a more detailed three-dimensional understanding."
9	Which virtual dissection features or functions were most useful for your learning?	Rotatable 3D models: 56 (62.92%); layer-by-layer dissection: 42 (47.19%); highlighting/isolation of structures: 29 (32.58%); personal annotations: 18 (20.22%); cross-sectional views: 9 (10.11%).	—
10	Did you experience any technical difficulties or limitations while using virtual dissection?	Lack of tactile feedback: 68 (76.40%); limited anatomical variation: 12 (13.48%); reduced emotional impact: 11 (12.35%); dependence on software, updates and internet connectivity: 8 (8.98%).	—
11	How would you rate the level of anatomical detail available through virtual dissection compared with conventional methods?	Improved visualization: 54 (60.67%); greater interactivity: 36 (40.44%); consistency of visualization: 18 (20.22%).	"The virtual table provides detailed three-dimensional visualization of anatomical structures." "Different planes and viewing angles allow structures and cross-sections to be examined in ways that are difficult to reproduce with conventional methods."
12	Do you think virtual dissection can adequately prepare students for	56 (62.92%) responded positively, citing detailed visualization and spatial relationships relevant to areas such as radiology and surgery, as well as opportunities for repeated practice. 33 (37.07%) responded	"Virtual dissection by itself may not provide sufficient preparation for clinical practice because important hands-on skills cannot be reproduced." "Standardized digital models cannot completely represent the anatomical

	clinical practice? Why or why not?	negatively, mainly because of limited tactile experience and anatomical variability.	variations encountered in real patients." "Experience with actual dissection contributes to confidence and preparedness for clinical situations."
13	What role does virtual dissection play in collaboration and teamwork among medical students?	Interactive learning environment: 45 (50.56%); peer learning and teaching: 24 (26.96%); improved communication: 13 (14.60%); interprofessional learning: 5 (5.61%).	"It encourages students to discuss findings, ask questions and exchange ideas during learning." "Teaching each other reinforces understanding and creates a supportive learning environment." "It can facilitate collaboration between students from different healthcare disciplines."
14	What challenges may students encounter when learning anatomy through virtual dissection?	Lack of tactile feedback: 65 (73.03%); limited realism: 56 (62.92%); reduced emotional impact: 54 (60.67%); cognitive overload: 21 (23.59%); difficulty developing clinical skills: 19 (21.34%).	"The large amount of additional information and interactive functions can sometimes become overwhelming and distract from the core anatomy." "Virtual learning may not adequately prepare students for the emotional aspects of clinical practice." "Human anatomical variation and complexity cannot be completely represented by a virtual model." "The texture and physical properties of tissues are difficult to appreciate digitally."
15	What changes could make virtual dissection more effective for anatomy learning?	Greater realism: 69 (77.52%); case-based learning integration: 37 (41.57%); improved real-time collaboration, including shared annotations and group discussions: 29 (32.58%); simpler and more intuitive interface: 17 (19.10%); integrated assessment tools: 9 (10.11%).	"Including quizzes, self-assessment and immediate feedback could help students monitor their progress." "The software should be compatible with a wider range of devices, including affordable computers and mobile devices." "Haptic technology could potentially provide a better sense of tissue resistance and texture."

Note: The qualitative responses were categorized into recurring themes based on the students' comments. Because participants could mention more than one theme in several questions, the percentages are not expected to sum to 100%.

Discussion

Anatomy is a foundational component of undergraduate medical education and has traditionally been taught through cadaveric dissection, supplemented by didactic lectures. With the implementation of competency-based medical education (CBME), there has been a progressive shift toward active, learner-centered approaches that emphasize integration of theoretical knowledge with practical application, continuous assessment, feedback, individualized learning, and development of lifelong learning skills[4]. Although cadaveric dissection remains an important method for developing three-dimensional and spatial understanding of the human body, limitations such as increasing student numbers, restricted availability of cadavers, and the need for interactive learning experiences have encouraged the incorporation of digital technologies into anatomy education[5].

Virtual dissection represents one such technology-assisted approach. Three-dimensional digital platforms allow students to visualize anatomical structures from multiple perspectives and may facilitate spatial understanding, repeated practice, and self-directed learning[6]. Previous studies have suggested that virtual dissection can improve students' understanding and retention of anatomical knowledge and may have a positive influence on their learning experience [1,7]. However, the available evidence does not indicate that virtual dissection should replace conventional cadaveric teaching. Rather, most studies support its use as a complementary educational resource[17,18]. Combining multiple teaching strategies may therefore provide a more comprehensive learning experience than relying exclusively on a single method[19,20].

Previous investigations have reported favorable perceptions of combining virtual and traditional dissection. Funjan et al. found that medical students preferred an approach incorporating both cadaveric dissection and an interactive virtual dissection table over either method alone[3]. Similarly, Ralte et al. reported favorable perceptions of a combined approach involving cadaveric and three-dimensional virtual dissection[21]. Other studies have demonstrated that integrating virtual resources with conventional gross anatomy teaching may improve learning outcomes while potentially reducing some of the logistical limitations associated with cadaver-based teaching[22].

In the present study, students were exposed to virtual dissection as a supplementary component of their anatomy education. Among the 89 respondents, 21 (23.59%) reported previous exposure to virtual dissection or similar digital anatomy resources. No significant difference was observed between high and low academic achievers in terms of previous exposure. Students reported spending an average of 3.76 ± 2.1 hours per week using the virtual dissection platform. Notably, high academic achievers reported greater weekly use (4.62 ± 1.5 hours**)** compared with low academic achievers **(**2.24 ± 0.9 hours**).**

More than half of the participants, 53 (59.55%)**,** reported enjoying anatomy learning through virtual dissection. A statistically significant difference was observed between high and low academic achievers, with mean scores of 4.3 and 2.8**,** respectively. This difference may reflect variations in familiarity with technology, confidence in learning, or ability to navigate three-dimensional digital environments. Students who experience greater academic difficulty may require more initial guidance when using unfamiliar digital platforms and may therefore be less confident during the early stages of implementation.

At the same time, 58 (65.16%) students indicated that virtual dissection alone, without accompanying lectures or other teaching approaches, was insufficient for acquiring comprehensive anatomical knowledge. This finding reinforces the importance of maintaining faculty-guided teaching alongside technology-assisted learning rather than treating virtual dissection as a standalone replacement for conventional instruction.

The perceived educational benefits of virtual dissection were substantial. Sixty-five students (73.03%) reported that it improved their understanding of lectures, while 55 (61.79%) felt that it increased their motivation to study. Furthermore, 57 (64.04%) perceived virtual dissection as supporting continuous learning, and 70 (78.65%) believed that it promoted deeper learning of anatomy. Statistically significant differences between high and low academic achievers were observed for these four domains. One possible explanation is that students with lower academic achievement may initially encounter greater difficulty with software navigation and the mental manipulation of three-dimensional anatomical structures. Differences in academic confidence may also influence how students respond to unfamiliar technology-based learning environments.

Several other perceived benefits were reported without significant differences between academic-achievement groups. These included systematic acquisition of knowledge **(**52, 58.42%**),** improved memorization **(**72, 80.89%**),** enhancement of academic performance **(**63, 70.78%**),** interactive group discussion **(**70, 78.65%**),** and reduction of anxiety associated with learning anatomy **(**42, 47.19%**).** The absence of significant differences suggests that these potential benefits may be experienced across different levels of academic achievement. The visual and interactive characteristics of virtual dissection, together with opportunities for repeated exploration and revision, may support students with different learning needs.

The importance of faculty guidance was also evident. Seventy-one students (79.77%) preferred to have an instructor available to guide them during virtual dissection, whereas 77 (86.51%) preferred having access to the virtual platform at any time for independent learning. These findings suggest that students value the flexibility of self-directed digital learning while simultaneously recognizing the importance of faculty supervision. Instructor involvement can provide structure, maintain appropriate learning pace, clarify difficult concepts, and facilitate group discussion and peer learning.

Despite the perceived benefits of virtual dissection, students continued to favor cadaveric dissection for learning anatomy. Forty-nine students (55.06%) did not prefer virtual dissection over cadaveric dissection, and 67 (75.28%) specifically stated that virtual dissection should be used as a supplement to cadaveric dissection rather than as a replacement. This finding is consistent with previous literature supporting a blended approach to anatomy education[23].

Cadaveric dissection provides direct exposure to human tissues, anatomical variability, and tactile information that cannot be completely reproduced through a digital platform. Students may therefore perceive virtual dissection as particularly useful for visualization, revision, and initial exploration, while regarding cadaveric dissection as essential for developing a more realistic understanding of anatomical structures and their relationships.

The qualitative feedback also highlighted several advantages of virtual dissection, including comprehensive visualization, interactive exploration, repeatability, flexible learning pace, and opportunities for dynamic learning. At the same time, students identified limitations such as the absence of tactile feedback, reduced anatomical realism, limited emotional and experiential engagement, potential cognitive overload, and difficulty translating virtual learning into certain clinical or practical skills.

These findings suggest that the effectiveness of virtual dissection may be improved through thoughtful integration with other teaching strategies. Students suggested that greater anatomical realism, incorporation of case-based clinical scenarios, improved opportunities for real-time collaborative learning, user-friendly interfaces, and integrated assessment and feedback tools could enhance the educational value of virtual platforms.

Overall, the findings support a blended model of anatomy education in which virtual dissection complements rather than replaces cadaveric dissection. Virtual resources can provide repeated, flexible, and interactive opportunities for learning and revision, while cadaveric dissection continues to provide essential tactile and experiential exposure. Careful selection of appropriate software, compatibility with available devices, faculty training, and technical support will be important for successful implementation.

Limitations

This study has several limitations. First, it was conducted at a single medical college with a relatively limited number of participants; therefore, the findings may not be directly generalizable to students from other institutions.

Differences in curriculum structure, educational environment, technological exposure, learning preferences, and cultural or educational backgrounds may influence students' perceptions of virtual dissection.

Second, the study was questionnaire-based and primarily assessed students' perceptions rather than objective measures of learning. Consequently, the findings reflect self-reported experiences and may be influenced by response or social-desirability bias. As the questionnaire was administered electronically, additional sources of bias may include self-selection, non-response, survey fatigue, distraction while completing the questionnaire, misunderstanding of individual items, and inattentive or random responses.

Third, the study evaluated students' perceptions at a particular stage of their anatomy education and therefore cannot establish whether the perceived benefits of virtual dissection are sustained over time. Longitudinal assessment using objective measures of anatomical knowledge and practical performance would provide stronger evidence regarding its educational effectiveness.

Finally, the present analysis did not specifically examine whether perceptions differed according to gender. Future studies with larger and more diverse samples could investigate gender-related differences as well as other factors that may influence students' responses to technology-assisted anatomy education.

Conclusion

The findings of the present study support the use of virtual dissection as a complementary tool in undergraduate anatomy education**.** Students perceived several benefits, particularly in relation to visualization, deeper learning, motivation, knowledge retention, and opportunities for repeated self-directed learning. However, the majority did not consider virtual dissection an adequate replacement for cadaveric dissection.

Differences between high and low academic achievers indicate that students may not experience technology-assisted learning in the same manner, emphasizing the importance of appropriate faculty guidance and structured introduction to virtual learning platforms. Virtual dissection may be particularly valuable for revision and incremental learning, while cadaveric dissection remains important for tactile, spatial, and experiential understanding.

Therefore, a balanced combination of cadaveric dissection, faculty-led teaching, and virtual anatomy resources may provide the most comprehensive approach. Such an integrated model can accommodate diverse learning needs while preserving the essential educational benefits of direct anatomical dissection.

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