ORIGINAL RESEARCH

Digital Scalpel, Virtual Classroom: Unmasking Specific Challenges in Distance Anatomy Education

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ABSTRACT
Objective: Traditional anatomy education (TAE) traditionally relies on hands-on experiences with cadavers and materials for three-dimensional comprehension, a facet often lacking in distance anatomy education (DAE). With the paradigm shift brought on by the COVID-19 pandemic, necessitating the transition of in-person training to remote modalities, this study aims to assess students' perceptions of the effectiveness of DAE and proposes strategies to enhance its efficacy in future implementations. **Methods:** A survey instrument, administered to first-year students of the MBBS during the 2019–2020 academic year, comprised demographic information and voluntary consent, alongside sections soliciting suggestions for DAE improvement and comparisons with other basic medical science courses in distance education. Utilizing a Likert scale (1=strongly disagree to 5=strongly agree), the questionnaire was disseminated through Google Forms for online completion. **Results:** Majority(82.4%) of respondents expressed disagreement or strong disagreement with the statement "DAE is more efficient than TAE." While 58.6% conveyed dissatisfaction with theoretical education in DAE, this figure increased to 79.9% concerning practical education. The findings underscore a perceived inefficiency of DAE, particularly in the context of practical lessons, compared to TAE. **Conclusion:** The study concludes that the efficiency of DAE, particularly in practical lessons, is perceived to be inferior to TAE. Addressing this disparity requires future efforts to design an innovative syllabus tailored to the distinctive demands of DAE, thereby positioning it as a robust alternative to traditional in-person methods.
Keywords: COVID-19 pandemic, Distance Anatomy Education (DAE), Traditional Anatomy Education (TAE), Remote learning, Student perceptions

INTRODUCTION

The global impact of the COVID-19 pandemic, which emerged in December 2019, has reverberated across various sectors, exerting profound effects on the economy and education alike [1]. As a crucial measure to mitigate the spread of the infection, social distancing has necessitated a shift from traditional face-to-face (F2F) education to remote modalities in numerous countries, thereby unveiling unforeseen challenges in distance education [2, 3]. Within the realm of medical education, the transition to remote learning has particularly underscored difficulties in delivering anatomy courses during the preclinical phase [4].

Anatomy holds paramount importance in medical education, symbolized by its etymological roots in "cutting up." Traditional Anatomy Education (TAE) represents a longstanding and foundational approach to imparting anatomical knowledge in medical education. Rooted in the centuries-old practice of cadaver dissection, TAE has historically served as the primary method for medical students to comprehend the intricacies of the human body's structure. In TAE, students engage with various learning modalities, including hands-on dissection of cadavers, examination of anatomical models, and participation in discussions with peers. The traditional classroom setting fosters a comprehensive understanding of anatomy through visual, tactile, and collaborative

learning experiences. While TAE has been the cornerstone of medical education, it has also faced challenges, such as a shortage of cadaver donors and the emotional impact of cadaveric dissection on students. Despite these challenges, TAE remains deeply ingrained in the medical education landscape, emphasizing the significance of direct engagement with anatomical specimens for aspiring healthcare professionals.Traditional anatomy education (TAE) traditionally relies on cadaver dissection, yet technological advancements and a shortage of cadaver donors have prompted a decline in this practice [5, 6]. Paradoxically, studies reveal that cadaveric contact induces negative emotions such as fear and anxiety among students [7]. While the need for alternative anatomy education models has intensified, a consensus on the most suitable methods remains elusive.

In recent years, there has been a transformative shift in anatomy education with the integration of cutting-edge technologies, particularly Virtual Reality (VR) techniques and digital modes. These innovative approaches offer a departure from traditional methods, providing students with immersive and interactive experiences in the study of human anatomy. Virtual Reality, in particular, allows learners to explore three-dimensional anatomical structures in a simulated environment, providing a level of detail and interactivity previously unimaginable. Digital modes encompass a range of tools, from interactive anatomy apps to online platforms featuring 3D models and visualizations. These newer methods not only enhance accessibility but also cater to varied learning styles, allowing students to engage with anatomical concepts at their own pace. The use of digital modes and VR techniques in anatomy teaching marks a significant leap forward, offering dynamic, engaging, and flexible learning experiences that align with the evolving landscape of medical education.At medical college of western India, TAE is multifaceted, employing cadavers, lifelike plastic models, three-dimensional (3D) applications, and visual aids. In the traditional setting, students engage with various learning styles—seeing, touching, 3D perception, association, and small group discussions—facilitating a comprehensive understanding of anatomy. However, the transition to distance anatomy education (DAE) has disrupted the utilization of these diverse learning styles. Activities integral to the traditional classroom experience, such as discussions, hands-on practice, and peer teaching, have become inadequate or ceased altogether.

While literature on DAE exists, few studies incorporate comprehensive feedback from students. This study seeks to address this gap by evaluating the efficiency of DAE and providing a comparative analysis of DAE and TAE from the students' perspective. Additionally, the study captures student insights regarding the comparison of distance education courses in anatomy with those in other basic medical sciences.

METHODOLOGY

Study Population

The study targeted 250 first-year students of MBBS students of a medical college in western India. A total of 239 students formed the study sample, and ethical approval for the questionnaire was obtained from the Institutional Review Board. 11 students were unable to fill the form.

Questionnaire Design

The questionnaire, divided into three sections, commenced with introductory statements outlining its purpose, study goals, and the voluntary nature of participation. The first section comprised demographic inquiries, encompassing age, gender, family income, and location. The second section incorporated proposals sourced from existing literature, formatted using a Likert scale (1=totally disagree to 5=totally agree) [8-10]. This section also featured statements assessing the efficacy of Distance Anatomy Education (DAE) and comparing it with other basic sciences' distance education. The final section included a non-mandatory open-ended question inviting students to share their perspectives on enhancing DAE.

Data Collection

The questionnaire, constructed on Google Forms, was disseminated to students electronically. Cronbach's alpha coefficient, a measure of overall reliability for the Likert scale questions, was calculated, yielding a coefficient of 0.745, affirming high internal consistency. Frequency analysis was employed to interpret the collected data.

Educational Background

Participants had commenced their anatomy education in the fall semester, initially receiving face-to-face (F2F) training until the middle of the spring semester. Subsequently, COVID-19 measures prompted a transition to remote learning, allowing participants to gain firsthand experience in comparing Traditional Anatomy Education (TAE) and DAE. In our faculty, DAE was implemented through vocalized presentations and videos showcasing anatomic structures derived from laboratory materials and cadaveric specimens. Notably, only topics such as bones, joints, and upper extremity muscles were covered face-to-face, while DAE addressed muscles of the lower extremity and trunk, peripheral vessels, and nerves.

RESULTS

Demographic Profile

The study cohort comprised 54.8% females and 45.2% males, with the majority (84.1%) falling within the 17–21 age group.

Student Perceptions on Teaching Practices

Regarding the statement "DAE makes the student more active in terms of teaching practices," 59.4% of students disagreed, while 27.2% disagreed that "DAE enables students to learn at their own pace." A significant portion (26.8%) expressed difficulty in organizing their working time during remote education.

Effectiveness of DAE

A considerable proportion (47.3%) disagreed with the statement "DAE is suitable for me." Over 80% of participants were skeptical about the effectiveness of DAE, with 66.1% strongly disagreeing and 16.3% disagreeing with the proposal that "DAE is more effective than TAE." Dissatisfaction with theoretical education in DAE was indicated by 58.6% of students, rising to 89.9% for practical education.

Table 1: Results of all expressions on "personal suitability, student autonomy, and technical issues"

Expressions (n = 239)	Totally disagree	Disagree	Neutral	Agree	Totally agree
DAE saves time	97 (40.6%)	51 (21.3%)	53 (22.2%)	19 (7.9%)	19 (7.9%)
DAE provides locational flexibility	65 (27.2%)	50 (20.9%)	65 (27.2%)	35 51(6%)	24 (10.0%)
DAE enables students to learn at their own pace	65 (27.2%)	55 (23.0%)	62 (25.9%)	39 (16.3%)	18 (7.5%)
DAE makes the student more active in terms of teaching practices	142 (59.4%)	47 (19.7%)	30 (12.6%)	5 (6.3%)	5 (2.1%)
Content of the lessons in DAE is sufficient in terms of learning	113 (47.3%)	71 1(29.7%)	31 (13.0%)	17 (7.1%)	7 (2.9%)
DAE provides a decent learning opportunity for people	105 (43.9%)	71 (29.7%)	38 (15.9%)	18 (7.5%)	7 (2.9%)
In DAE, I decide myself what and how to learn	51 (21.3%)	47 (19.7%)	62 (25.9%)	54 (22.6%)	25 (10.5%)
In DAE, I can organize the working time according to myself	38 (15.9%)	26 (10.9%)	64 (26.8%)	69 (28.9%)	42 (17.6%)
In DAE, I play an active role in the learning process	67 (28.0%)	55 (23.0%)	4 (26.8%)	37 (15.5%)	16 (6.7%)
In DAE, I have a unique learning style	41 (17.2%)	39 (16.3%)	73 (30.5%)	60 (25.1%)	26 (10.9%)
I was able to get technical support when I had problems accessing the system	33 (13.8%)	37 (15.5%)	104 (43.5%)	31 (13.0%)	34 4(14.2%)
I was able to get the necessary support when I had problems with the lessons	58 (24.3%)	59 (24.7%)	2(34.3%)	24 (10.0%)	16 (6.7%)
I was able to convey my requests and suggestions about the courses to the authorities	55 (23.0%)	76 (31.8%)	72 (30.1%)	4 (10.0%)	12 (5.0%)
When necessary, I was able to interact with the lecturers of the courses	71 (29.7%)	74 (31.0%)	63 (26.4%)	21 (8.8%)	10 (4.2%)

Table 2: Results of all expressions on "learning, effectiveness, and satisfaction"

Expressions (n = 239)	Totally disagree	Disagree	Neutral	Agree	Totally agree
DAE provides the convenience of receiving education from home	62 (25.9%)	38 (15.9%)	65 (27.2%)	40 (16.7%)	34 (14.2%)
I think DAE is suitable for me	113 (47.3%)	51 (21.3%)	35 (14.6%)	26 (10.9%)	14 (5.9%)
DAE is a suitable alternative for the training I need	93 (38.9%)	70 (29.3%)	39 (16.3%)	25 (10.5%)	12 (5.0%)
DAE is suitable for me due to the intensity of my work	107 (44.8%)	52 (21.8%)	38 (15.9%)	24 (10.0%)	18 (7.5%)
In DAE, I was satisfied with the anatomy practical training	137 (57.3%)	54 (22.6%)	33 (13.8%)	8 (3.3%)	7 (2.9%)
In DAE, I was satisfied with the anatomy theoretical training	66 (27.6%)	74 (31.0%)	64 (26.8%)	23 (9.6%)	12 (5.0%)
Overall, I was satisfied with the DAE	78 (32.6%)	85 (35.6%)	47 (19.7%)	19 (7.9%)	10 (4.2%)
DAE ensures permanent learning	144 (60.3%)	48	34	9 (3.8%)	4 (1.7%)

		(20.1%)	(14.2%)		
I understood the lessons in DAE	69 (28.9%)	82 (34.3%)	60 (25.1%)	22 (9.2%)	6 (2.5%)

Table 3: Results of all expressions on "challenges in distance education unique to anatomy" and "TAE vs DAE"

Expressions (n =239)	Totally disagree	Disagree	Neutral	Agree	Totally agree
DAE is more effective than TAE	158(66.1%)	39(16.3%)	25(10.5%)	11(4.6%)	6(2.5%)
In TAE ,anatomy practice lessons provide the advantage of three - dimensional thinking and visual perception ,as they include materials such as models and cadavers	5(2.1%)	7(2.9%)	20(8.4%)	66(27.6%)	141(59.0%)
In TAE ,it takes more time to comprehend practical lessons in anatomy (model .cadaver lessons .etc.)compared to other basic science courses (physiology ,histology - embryology ,microbiology)	6(2.5%)	11(4.6%)	53(22.2%)	95(39.7%)	74(31.0%)
In distance education ,basic science courses other than anatomy are easier to learn than anatomy	10(4.2%)	14(5.9%)	78(32.6%)	73(30.5%)	64(26.8%)
I had more difficulty in DAE compared to distance education of other basic science courses	5(2.1%)	19(7.9%)	50(20.9%)	75(31.4%)	90(37.7%)

Table 4: Results of all expressions on "What to do in DAE in the future?"

Totally disagree	Totally Disagree	Totally Neutral	Totally Agree	Totally agree
6 (2.5%)	11 (4.6%)	74 (31.0%)	54 (22.6%)	94 (39.3%)
5 (2.1%)	1 (0.4%)	37 (15.5%)	73 (30.5%)	123 (51.5%)
41 (17.2%)	36 (15.1%)	92 (38.5%)	32 (13.4%)	38 (15.9%)
2 (0.8%)	1 (0.4%)	28 (11.7%)	62 (25.9%)	146 (61.1%)

Challenges in Anatomy Education

More than half of the students acknowledged increased difficulty in anatomy during distance education compared to other basic science courses, with 37.7% totally agreeing and 31.4% agreeing. Additionally, a majority agreed that learning anatomy practice lessons took more time than other basic medical science courses in face-to-face education (31% totally agreeing and 39.7% agreeing).

Student Preferences for DAE Improvement

Students expressed support for suggestions to rearrange DAE course contents (51.5% totally agreeing) and incorporate more visual materials (61.1% totally agreeing).

Student Suggestions for Improving DAE

In response to an open-ended question, sixty-six students emphasized the indispensable nature of face-to-face classroom interaction for understanding practice lessons, advocating for a hybrid education model. Students conveyed a strong desire to return to physical classrooms and proposed enriching lectures with visual materials, additional explanatory videos, synchronous lessons, 3D program support, and lectures on YouTube channels.

DISCUSSION

Learning Models and Practical Aspects

Significant disparities exist between learning models in Traditional Anatomy Education (TAE) and Distance Anatomy Education (DAE). The physical nature of anatomy education, especially the practical component, necessitates a tangible environment. Active learning methods, including discussions and explaining concepts to peers, are proven to enhance learning efficiency, as highlighted in the literature [11]. Touching cadavers, engaging with models, and participating in dissection sessions contribute to the development of students' anatomical abilities.

Student Perceptions and Efficiency of DAE

Our study sought to evaluate students' perspectives on the advantages and disadvantages of DAE and gather insights into necessary future changes. The results indicate that students perceive DAE as less efficient than TAE, expressing dissatisfaction with both theoretical and practical aspects. However, there is a relatively positive reception concerning individual suitability and student autonomy.

Challenges in DAE

Concerns related to DAE include difficulties in time management, distractions at home, and self-motivation deficiencies, as highlighted in other studies [12]. The familiarity of students with traditional education may contribute to their dissatisfaction with online learning. While students expressed satisfaction with the freedom and flexibility of DAE, technical issues, autonomy, and suitability were areas of concern.

Efficiency of Video-Based Training

The study explored the efficiency of practical training conducted solely through videos. While students acknowledged the potential benefits of using more video materials, the overall effectiveness of video-based practical training was perceived as low. Future enhancements might include adding anatomical structure names as subtitles in lecture videos to increase efficiency.

Comparisons between TAE and DAE

Students consistently conveyed a strong preference for TAE, emphasizing its irreplaceable nature. Similar sentiments were echoed in other studies where students expressed a sense of loss in clinical skills and negative impacts on laboratory-based training [13]. The challenges of achieving traditional education quality in subjects requiring intensive practicals were evident, with students expressing dissatisfaction, particularly with the practical aspect of DAE.

Unique Challenges in Anatomy Education

Anatomy, being a practice-based course, presents unique challenges in distance education. Students reported difficulties in practical experiences, leading to negative sentiments toward lessons that demand hands-on involvement. Studies have suggested that a combination of traditional and virtual dissection may improve learning outcomes [14]. The visual and 3D nature of anatomy learning emphasizes the necessity of face-to-face practice, making DAE less efficient in its current form.

Future Directions for DAE

To address the challenges of DAE, future developments should focus on creating a more efficient syllabus adaptable to natural disasters or emergencies. Technological advancements play a crucial role, with emerging possibilities like quizzes, competitions, social communication tools, and interactive discussions proving beneficial in online training [15, 16]. Students in our study expressed consensus towards reorganizing future DAE to be more interactive and visually enriched.

Integration of Technology in Anatomy Education

The integration of technology in anatomy education is evolving. New generation students require anatomical education equipped with modern technologies. Virtual Reality (VR) systems, such as 3D VR workshops, have the potential to enhance student participation and understanding of anatomical structures [17]. The use of anatomy education models coupled with technology is on the rise, emphasizing the increasing importance of systems integrated with technology in the future of anatomy education [18, 19].

CONCLUSION

Our study sheds light on the perceived low efficiency of Distance Anatomy Education (DAE) based on feedback from students in our faculty. However, it is crucial to acknowledge that our findings are limited to our specific institution and may be influenced by various factors, including teaching methods, technical competencies, didactic differences, and the specific anatomy topics covered. Controlled national and international studies, involving similar student groups, instructors, and curriculum content, can help mitigate potential confounding factors and provide more generalizable insights.

Looking ahead, the future of distance education requires students to cultivate self-discipline and engage in self-study. Implementing online laboratory classes with active lecturer participation can create a virtual classroom where students learn through discussions and teaching each other. Strengthening course content with quizzes and online participatory activities can enhance engagement and understanding. Given that practice-based lessons like anatomy exhibit lower efficiency in distance education, careful consideration should be given to organizing lesson schedules.

A powerful alternative for the future could be the adoption of a hybrid anatomy education model, where theoretical components are delivered online, and practical aspects are conducted face-to-face. This hybrid approach has the potential to address the unique challenges posed by practice-based lessons and cater to the diverse learning needs of students. Continuous efforts are imperative to enhance both theoretical and practical aspects of distance medical education. Evaluating various alternatives and investigating the effects of a hybrid education style will be essential in shaping the evolving landscape of medical education.

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