

## Experiences and effectiveness of multimodal approach in teaching Anatomy to medical students

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### Abstract

**Introduction and Aim:** Covering the Anatomy syllabus employing theory lectures followed by dissection might fail to transfer clinical concepts to 1<sup>st</sup> MBBS students. Eventually student's motivation to learn Anatomy fades, as they struggle to relate current teaching with future practice. This pilot study was conducted to assess the effectiveness of selected approaches to promote learning; and generate interest in the study of anatomy among 1<sup>st</sup> MBBS students.

**Materials and Methods:** This cross-sectional pilot study was conducted among small groups of 100 first MBBS students, who rated clinical case based approach, disclosure of learning objectives, weekly tests, peer assisted learning, model demonstrations, and student-led seminars using a 3-point Likert scale of 'useful/no change/not useful'. Statistical analysis was done using chi-square test.

**Results:** Out of 32 female and 14 male respondents, reported usefulness was 89% for weekly test; 86% for clinical case-based learning; 82% for model demonstrations; and 72% for disclosure of specific learning objectives. Peer assisted teaching learning was said to be useful by 80% of participants, while only 54.3% students perceived seminars as useful. Female respondents reported significantly greater usefulness for short tests, description of SLOs, peer learning, and student seminars compared to male respondents. There was no significant difference in reported usefulness between male and female respondents with respect to model demonstration and clinical case based learning.

**Conclusions:** It is possible to improve student interest and learning in Anatomy through weekly tests; case-based learning of clinical anatomy; disclosure of SLOs prior to each learning encounter; and peer-assisted learning (PAL).

**Keywords:** Case-based learning, Medical education, Model demonstration, Peer-assisted learning, Specific learning objectives, Student-led seminar.

### Introduction

Anatomy presents several challenges to first MBBS students. In addition to learning several new terms and concepts in a relatively short time period, they need to apply their learning to solve clinical problems.<sup>1,2</sup> Typically, Anatomy is taught through didactic lectures and cadaveric dissection.<sup>1</sup> The traditional approach of locating dissection after theory lectures is limited in its ability to both generate interest, and enable students to apply theoretical knowledge in their future practice.<sup>3</sup> Often, students memorize facts instead of understanding and applying the concepts.<sup>1</sup> Globally, several new teaching-learning approaches have been implemented to enhance student participation and learning. Among these, Problem Based Learning has proved effective in increasing both student participation and self-regulated learning.<sup>1,4</sup> Due to the specific requirements of teaching Anatomy, several other approaches have also been used to teach the subject. These include using mobile devices, social media platforms, 3 Dimensional Visualization Technologies (3DVT), Computer Assisted Learning (CAL), Computer Based Assessment (CBA), Learning Analytics (LA), and Learning Management Systems (LMS).<sup>3,5,6</sup> This article describes various learning approaches employed to facilitate learning of Anatomy in first MBBS students, and presents both learner and teacher perceptions regarding the experience. This will likely be of benefit to others engaged in the teaching of Anatomy at the

undergraduate level, allowing for better informed teaching-learning choices.

### Materials and Methods

This pilot study was conducted in the Anatomy Department of a private medical college in south Kerala, with an annual intake of 100 students for the MBBS course. After obtaining permission from the Department Head, various learning approaches were administered to all 100 1<sup>st</sup> MBBS students admitted in the academic year 2018. These were in addition to the regular classes and cadaveric dissection, and were spread over a period of one year. Each approach was implemented in small groups of 25 students, ensuring universal coverage and quality of intervention.<sup>3</sup>

Teaching-learning approaches tried:

#### Clinical Case Based Learning

Following a lecture, students were provided a clinical scenario to reinforce applied anatomy. Each scenario would be followed by appropriate questions that linked theory with future clinical practice. A set of questions were given following the case. During dissection hour, students were encouraged to discuss the case and identify the most appropriate answer to questions. The case would be discussed by the assigned facilitator, ensuring that all students participate by relating the relevant anatomical structure with its clinical relevance. Cases were brief, and designed to match students' knowledge level.<sup>7</sup>

**Sample clinical scenario**

75yr old man complaints of difficulty and increased frequency of micturition. Investigations ruled out carcinoma prostate. What is the most probable diagnosis? Which lobe of the prostate is more likely to be involved in this case? How to examine prostate enlargement clinically?

**Short test –weekly Formative Assessment**

Short tests were conducted on weekly basis and assessment was done through short answer questions (SAQs). Specific written feedback was provided to the students soon after the test. Feedback included suggestions on how to improve the presentation of the answers. The distribution of questions was aligned to the relative weightage of each topic in the syllabus. Care was taken to ensure appropriate distribution of questions from various topics keeping it relevant to the learning objectives of the course.<sup>3,8</sup>

**Peer Assisted Learning (PAL)**

Peer Assisted Learning (PAL) is defined as “People from similar social groupings who are not professional teachers helping each other to learn and learning themselves by teaching”.<sup>9</sup> Although such teaching is common among students, it is informal. PAL seeks to formally develop medical students’ teaching skills. Student volunteers with consistently good academic performance (tutors) were identified and provided guidance on tutoring their peers (tutees). Each student tutor was assigned four struggling learners, based on their own preferences. Student tutors were interviewed periodically to obtain feedback, and provide guidance regarding specific concerns.

**Demonstration using Models**

Complex anatomical structures like larynx, middle ear, dural fold and related dural venous sinuses, extra ocular muscles etc. are difficult to visualize and understand. Models- three-dimensional representations of structures, organs or regions- resemble true human anatomy.<sup>1,6</sup> Readily available models were used from the Department museum and some were made by the facilitators. Faculty demonstrated how to use the models, and established associations with structures in the cadavers. All students were encouraged to use the models and relate to prior teaching as well as cadaveric dissection. Student use of models was supervised by faculty.

**Student-led Seminars**

At the end of each region, the entire cohort was divided into groups of 5 students each. A list of topics was provided, and students were free to subdivide the topics further, and prepare the same.<sup>1,2</sup> Faculty chose students at random and asked them to present to their peers. The presentations were followed by a question and answer session, where anyone

from the audience could ask doubts and seek clarifications. Faculty would summarize the topics and provide feedback to the presenters.

**Disclosure of Educational Objectives**

Educational objectives/Specific learning objectives (SLOs) are variously defined as ‘intended change brought about in a learner’; ‘explicit formulations of ways in which students are expected to be changed by the educative process’; and ‘what the students should be able to do at the end of a learning period that they could not do beforehand’.<sup>10,11</sup> The SLOs were disclosed at the beginning of each learning session with the intention of focusing learners’ attention and efforts.

**Ethical Considerations**

The approaches were universally administered, ensuring that all students received the same, albeit in groups of 25. Feedback regarding the approaches was solicited at the end of the academic year, excluding any possibility of differential treatment of students based on their participation status. In addition, the feedback was anonymous and voluntary- the latter evident from the number of respondents.

**Data Analyses**

Students’ experiences were captured through two approaches- rating along a three-point Likert scale (Useful/No Change/ Not Useful); and unstructured qualitative feedback. All responses were collected anonymously. Although all 100 students were invited to respond, only 46 did so. Data entry was performed using MS Office Excel 2013. Statistical analyses were performed using EZR (ver. 1.36).<sup>12</sup> Ordinal data were transformed to create binary variables. In addition to descriptive statistics, chi-square test was performed with gender as independent variable.<sup>13,14</sup> Statistical significance was set at the 5% level. Qualitative data was sorted and coded to identify common themes.

**Results**

Of the 46 respondents, 32(69.5%) were female, while 14(30.4%) were male. The mean (Standard Deviation) age was 18.39(0.57) years.

Reported usefulness of the various approaches is presented in Fig. 1. Perceived usefulness ranged from 54.3% for student seminars to 89.1% for weekly tests. With the exception of student seminars, all other approaches were rated as useful by at least 70% respondents.

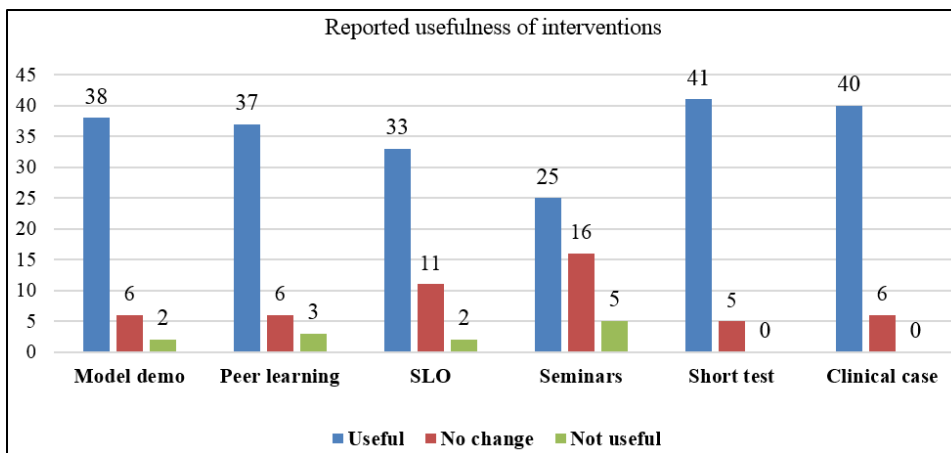


Fig. 1: Scores of interventions

Table 1: Significance and relevance of interventions by gender

Variable	Level	Useful	Others	Odds Ratio	95% CI	p value
Clinical case	Female	30 (93.8%)	2 (6.2%)	5.72	0.70-72.51	0.06
	Male	10 (71.4%)	4 (28.6%)			
Model demo	Female	27 (84.4%)	5 (15.6%)	1.45	0.19-9.12	0.68
	Male	11 (78.6%)	3 (21.4%)			
Peer Learning	Female	30 (93.8%)	2 (6.2%)	13.83	2.07-164.44	0.001
	Male	7 (50.0%)	7 (50.0%)			
Weekly test	Female	32 (100.0%)	0 (0.0%)			0.001
	Male	9 (64.3%)	5 (35.7%)			
Seminars	Female	22 (68.8%)	10 (31.2%)	7.66	1.57-52.32	0.004
	Male	3 (21.4%)	11 (78.6%)			
SLOs	Female	30 (93.8%)	2 (6.2%)	46.34	6.45-637.69	<0.0001
	Male	3 (21.4%)	11 (78.6%)			

Bivariate analyses were performed using the aforementioned transformed data (binary variables). Gender was taken as the independent variable, and chi-square test performed with the binary variables of perceived usefulness as dependent variable. Odds Ratios and 95% Confidence Intervals were estimated in addition to p-values.

Disclosure of SLOs; Peer Assisted Learning (PAL); conduct of formative weekly tests and student seminars achieved statistical significance ( $p < 0.05$ ), with female students significantly more likely to rate these as useful compared to their male counterparts. While female respondents were 46.34 times more likely to rate disclosure of SLOs as useful compared to male respondents; the odds declined to 13.83 times and 7.66 times for PAL and student seminars respectively. Although highly significant ( $p: 0.001$ ), Odds Ratio for weekly tests could not be calculated as one of the cells had a value of zero (Table 1).

**Qualitative feedback received from students regarding the Interventions**

1. Clinical case based approach.  
Positive Feedback: “Helps to retain the knowledge for a longer period.”, “lets us understand the reason for learning each structure of Anatomy”, “Builds interest in the subject”

Constructive feedback: Nil  
 2. Model demonstration:  
Positive feedback: “Achieves orientation towards the structure”, “Retains the visual image in memory for a longer period”  
Constructive feedback: Nil  
 3. Peer learning:  
Positive feedback: “It’s interesting and fun to learn from my friend”, “Feels free to ask questions”  
Constructive feedback: “Not practiced regularly”  
 4. Short test:  
Positive feedback: “Keeps me focused towards studies”, “Makes us learn on how to present and manage time while writing the test”  
Constructive feedback: Nil  
 5. Student seminar:  
Positive feedback: “Very useful in learning applied aspects of the topic from friends”, “Helped me improve my communication skills”  
Constructive feedback: Nil  
 6. Specific learning objectives:  
Positive feedback: “Helped us focus on must know and nice-to know topics”, “Oriented us on the skills to be acquired on daily basis”  
Constructive feedback: Nil

## Discussion

The inherent technical challenges of teaching Anatomy are compounded by the heterogeneity of students in terms of their grades, abilities, scientific literacy levels, cultural backgrounds and professional fields.<sup>1,2,15,16</sup> Nevertheless, the importance of Anatomy as a core subject in the practice of medicine mandates the employment of diverse methodologies to improve the learning experience for students. We will discuss each of the approaches tried in the present study in turn:

### Clinical case Based Learning

Of the respondents, 86% of students found the case based approach to be useful. While 11.9% of the respondents reported an improvement in comprehension; 16.6% experienced improvements in retention and recall. In the absence of a formal Problem-Based Learning (PBL) curriculum, this approach may enhance self-directed learning, critical thinking, and problem solving skills among students. These findings are consistent with those reported by Nair SP et al, who reported that 84% of students receiving Case Based Learning (CBL) felt the experience would be helpful in future practice. Further, 98% of students receiving CBL reported enhanced motivation and comprehension compared to didactic lectures.<sup>17</sup> CBL also provides opportunities to integrate the study of Anatomy with other (clinical) disciplines. Given the perception of students that clinical Anatomy is not given due importance, the inclusion of CBL is likely to mitigate such feelings, while simultaneously boosting motivation for learning and application of knowledge.<sup>1,2,15</sup>

### Weekly Test

Of the respondents, 89% rated this intervention to be useful. Feedback received from the respondents indicates that regular weekly tests helped them to improve the presentation of answers, and time management in examinations.

The reported usefulness of weekly tests is consistent with findings of other investigators, who reported student preference for such assessment in Anatomy.<sup>15,16</sup>

The effect of testing on learning has been described in literature, and is known to improve performance by providing authentic feedback of learning, and facilitating recall.<sup>18-20</sup> It is pertinent to note that in the absence of feedback, such testing is unlikely to yield benefits to learners.<sup>21</sup> In addition to the benefits of testing on learning, respondents reported a decrease in test anxiety as a consequence of the intervention.

### Peer Assisted Learning (PAL)

Although 80.4% of the respondents felt that PAL was useful, unstructured feedback indicates the benefit was greater for those who assumed the role of tutor, with 41.3% of tutors developing an interest in Anatomy. This is consistent with the findings of other investigators, who reported deeper understanding and greater interest developing as a result of PAL.<sup>22,23</sup>

Despite the benefits, tutors' initial enthusiasm faded over time, and many tutors were not consistent in teaching. As the teaching happened off-site in the hostels, direct

supervision was not possible. Although faculty attempted to maintain control over the situation, competing demands on students' time eventually won over PAL.

### Museum Models as Teaching Aids

The majority of respondents (82%) rated demonstration using models as useful. Models provide spatial orientation and enable students to visualize relations of complex structures, which reduce the need for rote memorization.<sup>3</sup> The findings of this study are similar to those reported from another study, where 71% of respondents preferred a judicious mixture of museum model usage along with dissection hall teaching.<sup>24</sup>

### Student-led Seminars (SLS)

Lowest usefulness rating was for student-led seminars (SLS), with only 54% of respondents finding them to be useful. This low value is consistent with the findings of Chakrabarti and colleagues. In their study, 54% of respondents indicated a preference for student seminars at the end of each region, claiming the same was very useful. The poor rating is indicative of student perceptions that SLS are a poor teaching-learning method. The problem could be remedied by incorporating changes in the conduct of the seminars, making them more student friendly.<sup>25</sup>

Faculty observed that not all students in a team would participate equally, limiting any benefits to those who did participate wholeheartedly. While the allocation of more time for such sessions could have helped, severe time constraint excluded that possibility.

### Disclosure of Specific Learning Objectives (SLOs)

The practice of disclosing SLOs was found to be useful by 71.75% of respondents. Feedback from the respondents indicates that this approach enabled better awareness of 'must know' topics. Although a small proportion of respondents did not find the approach useful, an overwhelming majority did. The disclosure of SLOs to learners has been demonstrated to improve academic performance through both an increase in students achieving a distinction grade, as well as a reduction in number of failures.<sup>26</sup> The limited evidence from this study indicates that disclosure of SLOs is a valuable tool to focus students' attention.

There are several limitations to this study, the most important being non-response bias. It is possible that the opinions of the respondents are at variance with those who did not respond. However, it would have been unethical to employ coercion. The choice of a three-point Likert scale was one borne out of a desire for simplicity, but this limited the data. Similarly, despite the best efforts of faculty, PAL remained largely uncontrolled. This indicates the need to employ robust designs for the implementation of PAL. In the absence of other socio demographic variables, gender was taken as an independent variable. Although analyses indicate a significant difference between male and female respondents in several approaches, the results must be considered with caution. Not only is there considerable risk of bias, the possibility of confounding cannot be ruled out, either.

Despite the limitations, this study demonstrates the potential of multiple inexpensive approaches to improve student interest and learning in Anatomy. These can be easily implemented in resource-limited settings, and adapted to suit local needs and circumstances.

### Conclusions

It is possible to improve student interest and learning in Anatomy through weekly formative assessment tests; case-based learning of clinical anatomy; disclosure of SLOs prior to each learning encounter; model demonstrations; and peer-assisted learning (PAL). Female students are significantly more likely than male students to find weekly tests, student-led seminars, peer-assisted learning (PAL) and disclosure of SLOs beneficial.

### List of Abbreviations

SLO- Specific Learning Objectives, SAQs – Short Answer Questions. SLS- Student-led Seminars, PAL- Peer Assisted Learning.

### Author's Contribution

1<sup>st</sup> author: Made substantial contribution in conception and acquisition of data. Corresponding author: Critically revised the manuscript, formulated the methodology and drafted important intellectual content. 2<sup>nd</sup> author: Gave final approval for this version of article to be published.

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