Original Article

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Anatomy Section

Re-Modernization of Dissection Hall Based on FAIR Principles of Learning – Evaluating the Perceived Learning Outcomes of First Year Medical Students

R RAJPRASATH[1], V DINESH KUMAR[2], MAGI MURUGAN[3], REMA DEVI[4]

ABSTRACT

Introduction: Owing to certain curricular and non-academic factors, dissection hall based teaching is slowly losing its rigour. In addition, we can't brush aside the fact that dissection hall not always cater the student's with varied learning styles. Applying the FAIR principles of learning (Feedback, Active learning, Individualization and Relevance) to dissection hall teaching would offer choices of studying from other available resources in the decreased contact hours.

Aim: To assess the perceptions of students regarding modernized dissection hall teaching and to record the advantages conferred by different instructional inputs.

Materials and Methods: The dissection hall teaching has been modified and the initiatives are described. At the end of first year anatomy curriculum after the university practical examination was over, the students were asked to respond to an anonymous pre-validated questionnaire regarding their accomplishment of learning outcomes while attending the dissection course, as well as their attitude towards dissections and priority of learning resources. Statistical analysis of the questionnaire was done using SPSS version 21. Mean and the standard error of mean were calculated for quantitative variables.

Results: Most of the students have strongly agreed that the dissection had made learning anatomy more interesting with a mean score of 4.78. Majority of students (88.4%) felt that doing dissection helped them to a great extent in developing learning via tactile/kinaesthetic senses. The priority mapping of the learning outcomes from different resources and preferentiality of various learning utilities are solicited.

Conclusion: In the process of creating an enriched learning environment, we tried to provide multi-sensory input to the student by adopting the FAIR principles of learning. Out of various modalities presented to them, students still consider cadaveric dissection superior owing to the learning outcomes provided by it. The re-modernization attempt is widely received by the students with positive response.

Keywords: Advance organizers, Anatomy teaching, Millennial generation, Multimodal learning styles

INTRODUCTION

Dissection based teaching is one of the time-tested learning tool for anatomy education. The main objectives for dissection in the ancient period was to make the naïve medical students understand the different body systems and disposition of body organs, which would form a strong foundation for clinical years. However, a technological innovation such as computer assisted learning and virtual dissection table have created waves of discussion in the medical education arena and questions the role of authentic dissection in the digital era. Dissection laboratory sessions is said to impose a high cognitive load upon students [1] as they need to acquire procedural skills, understand the anatomical concepts, identify the structures in the specimen/cadaver and get oriented towards anatomical relationships [2].

Traditional dissection based teaching, which largely involves providing students with set of instructions and list of achievable outcomes, in terms of structures to be identified, is slowly losing its rigour [3]. Firstly, due to the curricular reform across Indian medical institutes which have led to the decrease in the time available for dissection, in its true sense. Secondly students often tends to view dissection only in terms of practical examination and this limits the potential values of the learning opportunity. Thirdly non-academic factors such as shortage of cadavers and high costs of maintaining dissection laboratories [4,5] also have contributed to the decrease in the effectiveness of dissection laboratory teaching. These changes call for devising innovative methods in teaching anatomy [6].

Knowles MS et al., had suggested that adult learners should be taught in a way that enables them to understand why that particular knowledge is being taught, acknowledge the diversity of learners (according to learning styles) and learn from their own deficits based on self-reflection [7]. For the first year students, "scaffolding" of preparatory activities is essential for easing the transition of the student from a pedagogical to adult learning styles [8]. Harden R et al., had distilled the key principles of effective learning to figure out four principles (FAIR principles) which can be used for day-to-day educational practice [9]. It includes feedback, active learning, individualization and relevance.

Applying these principles of learning to dissection hall teaching, we perceived that adding the component of "self-exploration" is the important part of dissection [10]. Students attending the dissection classes should be offered choices of studying from other resources available to them (e.g., Text books and multimedia learning). Research has shown that a dissection course does not offer a uniform learning experience to all beneficiaries [11]. Students tend to have different approaches in dealing with dissection, thereby resulting in divergent learning experiences. Therefore, dissection course in solitude often result in differences in the amount of knowledge among students [11] and fortification of dissection experience by combination of instructional inputs tend to yield better outcomes. To achieve this, the dissection hall should be "value-added" to encourage diverse learning styles among learners and anatomy educators. Worldwide there is a dilemma to identify more efficient ways to utilize the fewer contact hours to the maximum extent.

In light of different learning methodologies being practiced, it is not uncommon for some of the learning outcomes being missed out during evaluation of a curricular reform [12]. According to Patel KM et al., learning outcomes should be the first priority, followed by devising appropriate educational methodologies and assessment strategies to deliver and ensure the achievability of those outcomes [13]. For meaningful learning to take place, learning materials need to be appropriately integrated and provided with a proper structure for thinking [14,15].

In this light, we, in our institute, have recently modified the dissection based teaching on the FAIR principles of learning [9]. Our principal aim was to encourage maximal learning in teams while counterbalancing the decreased contact hours. In addition, we tried to address few more questions such as: a) How do the students rank the individual activities for their usefulness in learning anatomy?; b) Whether the variety of learning activities helped the students achieve the learning outcomes of dissection course?; and c) How the students perceive the usefulness of multimodal format?

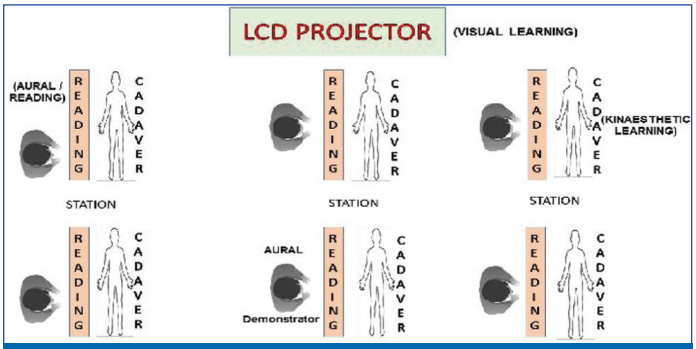
MATERIALS AND METHODS

This questionnaire based cross-sectional study was conducted in Pondicherry Institute of Medical Sciences during the academic year 2017-2018. All the 150 first year students underwent anatomy teaching in the dissection hall which was modernized as a part of curricular reform. As this was a part of curriculum evaluation, ethical clearance has been waived off. All students have a similar educational background. Traditional dissection classes which we had adhered to till last academic year followed classical dissection style where a maximum of 25 students were assigned to each cadaver and two faculty facilitated the process. The students didn't have access to textbooks apart from dissection manual or any other multimedia resources.

FAIR dissection hall description: The initiatives incorporated into the dissection hall are:

Initiative 1- Individualized Activity Based Learning: The traditional dissection classes offered little scope for catering the need for individual students. For example, a predominant "reading" or "visual" learners find it difficult to imbibe the knowledge by mere observation of dissection. In contrast, a "kinaesthetic" learner tends to learn with eagerness by dissecting. We made a provision of displaying the learning objectives, schematic representation of the region being dissected, clinical images and videos in the dissection hall using an overhead Liquid-Crystal Display (LCD) projector, flat screen and sound system (closed circuit audio-visual system). The PowerPoint® presentation containing these was played in loop and students were asked to observe that, whenever they get distracted.

In addition, small group teaching mediated by the faculty and peer discussion facilitated the auditory learners and reading from the textbook/atlas helped the visual learners. The main objective of this initiative was to present the content in multiple formats which would get reinforced in a better way [Table/Fig-1].



[Table/Fig-1]: Schematic representation of the dissection hall depicting the availability of different learning modalities to accommodate different types of learners in the study (visual learners, auditory learners, Readers, kinaesthetic learners).

Initiative 2- Ensuring Relevance: Adding relevance to the basic discipline teaching often creates a powerful and rich learning experience. We had used the advance organizers such as video clips and prosection demonstration. In addition, clinical vignettes and surgical videos pertaining to important were streamed in the dissection hall to increase the engagement of students.

Initiative 3- Feedback: For providing an effective feedback to the students, we conducted formative assessment every week and documented the performance of the students in the dossier format. The dossier format [16] included assessment of all three domains: cognitive, attitude and psychomotor and it helped us in tracking the learning curve of the students region wise.

At the end of the course (after completing the final examination about two months after the last dissection class), we invited the students to complete an anonymous pre-validated written questionnaire which we adapted based on previous study [17], regarding their accomplishment of learning outcomes while attending the dissection course, as well as their attitude towards dissections and priority of learning resources. The participation was purely on voluntary basis. The questionnaire consisted of 24 items out of which five items (Q1-Q4) were aimed at measuring the general perception towards dissection and next five items (Q5-Q9) for documenting the attitude towards dissection. In addition, we had incorporated nine items for recording the level of accomplishment of learning outcomes from the dissection course based on the data generated in a study [18] and six items for mapping the preferentiality towards different learning modalities we had in our dissection course. The items were re-checked and evaluated by three anatomists before usage. The total questionnaire Cronbach's alpha value was calculated as 0.7. The five-point Likert-scale survey including both negative and positive statements was used with options ranging from 1 "strongly disagree" to 5 "strongly agree." Statistical analysis of the questionnaire was done using SPSS version 21. Mean and the standard error of mean were calculated for quantitative variables.

RESULTS

Out of 150 first year students 121 students, who expressed the voluntary consent, responded to the feedback survey and the results were tabulated to estimate the values of central tendency. [Table/Fig-2] shows the general perceptions of students towards the role of dissection in learning of anatomy. Most of the students have strongly agreed that the dissection had made learning anatomy more interesting with a mean score of 4.78. A 56.2% students strongly agreed that dissection had deepened their understanding of anatomy with a mean score of 4.48 and 93.4% of students felt that dissection programme enhanced their respect towards human body (mean of 4.63). A total of 61.2% students strongly felt that dissection gave them a lasting knowledge about anatomy and helped in recalling the content in a better way (mean of 4.5). Similarly, majority of students felt that dissection gave them the three-dimensional perceptions of structure with a mean score of 4.55.

S.No	Questions	Likert scale (Responses in %)					Mean (± SEM)
		1	2	3	4	5	
1	Dissection had made learning anatomy more interesting	0	0	1.7	19	79.3	4.78 (0.04)
2	Had deepened my understanding of anatomy	0	2.5	3.3	38	56.2	4.48 (0.06)
3	It gave me a lasting knowledge and helped in better recalling, what I had learnt	0	1.7	7.4	29.8	61.2	4.50 (0.06)
4	It helped in perceiving three dimensional perspectives of structures	0	2.5	4.1	29.8	63.6	4.55 (0.06)

[Table/Fig-2]: Students' general perceptions of dissection in learning anatomy (1-strongly disagree, 5-strongly agree).

[Table/Fig-3] explains the feedback about the general attitude of the students towards dissection. A 72% of students felt that the dissection helped them to identify the structures in the cadaver better than learning from prosected specimens and 88% students felt that they liked the way dissection was carried out and they did not get bored. A 26% of students felt that dissection was time consuming and demanded a lot of physical work while 74% students did not agree to this notion. An 83% of students did not agree for the hypothetical situation of replacing dissection by newer teaching technologies. In addition, 96% students felt that the time allocated for dissection should not be compromised for lecture classes.

S.No	Questions	Yes (%)	No (%)
1	It was easier to find out structures in the cadaver than in the prosected specimens	72	28
2	I got bored by the way dissection was being carried out	12	88
3	Dissection is time consuming and demands lot of physical work	26	74
4	Dissection could be replaced by other methodologies of teaching such as demonstration of specimens, computer assisted learning etc.,	17	83
5	The time allotted for dissection could rather be used for lectures	4	96

[Table/Fig-3]: General attitude of students towards dissection.

Perceptions of students regarding various learning outcomes with respect to dissection hall experience are briefed in [Table/Fig-4]. An 86% of students strongly felt that their applied anatomical knowledge related to the clinical aspects increased to a great extent. An 86% of students felt that by doing dissection they were learning new contents (mean of 4.31) and 58.7% students strongly felt that by doing dissection they were acquiring new skills (mean of 4.44). A 71.1% of students felt that the objectives displayed via projector in the dissection hall have been achieved to a great extent. An 81% of students felt that learning via dissection had reinforced the contents taught in the lecture classes to a great extent. Majority of students (88.4%) felt that doing dissection helped them to a great extent in developing learning via tactile/kinaesthetic senses (mean score is 4.42). A 94.2% of students felt that they were relatively well engaged in the dissection classes and it was exciting to see the structures by doing dissection.

S.No	Questions	Likert scale (Responses in %)					Mean (± SEM)
		1	2	3	4	5	
1	Applied anatomical knowledge	0	0.8	13.2	33.9	52.1	4.37 (0.07)
2	Learning new content	1.7	2.5	9.9	35.5	50.4	4.31 (0.08)
3	Acquiring dissection skills	0.8	0.8	10.7	28.9	58.7	4.44 (0.07)
4	Meeting the objectives displayed via projector	0	6.6	22.3	43.8	27.3	3.92 (0.08)
5	Reinforcing contents taught in lecture hall	0.8	3.3	14.9	34.7	46.3	4.22 (0.08)
6	Tactile/kinesthetic learning	0	0.8	10.7	33.9	54.5	4.42 (0.07)
7	Engagement/excitement in seeing structures	0	0.8	5	26.4	67.8	4.61 (0.06)
8	Learning by interacting with peers	0.8	4.1	13.2	28.1	53.7	4.30 (0.08)
9	Learning by interacting with teachers	0	0.8	5.8	27.3	66.1	4.59 (0.06)

[Table/Fig-4]: Priority mapping regarding dissection hall experience by students (1-not at all, 5- to very great extent).

The usefulness of various modalities used in dissection hall as perceived by the students is depicted in [Table/Fig-5]. A 71.1% of students strongly agreed that hands on dissection of cadavers in dissection hall were useful for learning. A 35.5% strongly agreed that seeing the structures in prosected specimens helped them a lot in dissection hall (mean score of 4.11).

S.No	Questions	Likert scale					Mean (± SEM)
		1	2	3	4	5	
1	Hands-on dissection of cadavers	0	0.8	6.6	21.5	71.1	4.63 (0.06)
2	Seeing the structures in the prosected specimens	0	5	14.9	44.6	35.5	4.11 (0.08)
3	Reading from the textbooks/ atlas	1.7	18.2	31.4	31.4	17.4	3.45 (0.09)
4	Visualizing the images displayed via projector	0.8	7.4	35.5	35.5	20.7	3.68 (0.08)
5	Reciprocal learning with peers	0.8	4.1	15.7	35.5	43.8	4.17 (0.08)
6	Listening to the instructors	1.7	5	10.7	43.8	38.8	4.13 (0.08)

[Table/Fig-5]: Priority mapping by students regarding the modalities used for teaching in dissection hall (1- strongly disagreed to be useful, 5- strongly agreed to be useful).

DISCUSSION

Despite the winds of change in medical education, students often consider learning anatomy as a daunting task for a couple of reasons: a) the content-rich but volatile nature of the subject; b) inability to utilize the traditional teaching methods to the desired extent [19]. Variety in content delivery and the opportunity to interact either face-to-face with professors are appreciated by millennial generation students because of their varied learning styles [20,21]. We made an attempt to combine the strengths of multimodal learning in traditional dissection based teaching in a resource – economical way. By doing this, we tried to activate the existing knowledge; students had gained via prior lectures and deliver new knowledge in an incremental way, thus enabling a comprehensive knowledge gain.

Majority of the students (90.9%) could recall better from structures learnt during dissection and cadaveric dissection provided three-dimensional orientation to the structures in a better way (93.4%). This was in concordance with the study by Rizzolo LJ et al., which demonstrated that students who used a website on anatomy most frequentlyas the main resource for their learning about anatomy scored below the mean, compared to cadavers [22].

Another salient problem which we encountered in previous years was the dissonance in the ability of students to identify the structures seen in the prosected specimens when compared to same structures in the cadaver. In our previous study [23], 101 (82.8%) students were of the opinion that dissecting individually and feeling the structures help them understand superior than seeing the structures in prosected specimens. For re-enforcement and memorization students preferred seeing the structures in the cadaver/specimen repeatedly (63.9%). But the change in the orientation and inclination of structures in the specimen during examinations made the students turn enigmatic. In the present study also, majority of students (72%) confirmed that it is easier to find the structures in the cadaver. When asked whether dissection could be replaced by alternate methodologies which we had used as adjuncts, most (83%) expressed a strong negative nod. This data rejects the notion of reduction in the amount of contact hours dedicated for dissection and replace that time with learning sessions dedicated for interactions with prosections, as followed in some medical schools [24].

Another study [25] in which students exposed to PowerPoint®-based small group sessions performed superior in written exams than the oral exams because of the increase in the theoretical understanding of the particular topic. In the modified dissection hall settings, we tried to provide multi-sensory input to the students so that, in the creative atmosphere students could visualize the short segments of presentations, actively search the structures in the specimens/ cadaver and benefit out of small group discussion with teachers/

peers. We asked the students to do a priority mapping regarding the usefulness of individual modalities. Hands-on dissection of the cadavers was the most preferred modality with 71.1% students strongly favouring it. This was followed by reciprocal learning with peers (strongly favoured by 43.8%), listening to the faculty instructors (strongly favoured by 38.8%) and seeing the structures in the prosected specimens (strongly favoured by 35.5%). We attempted to provide students with objectives for each dissection session and images of that particular topic via projector. But it was perceived as the strongly favoured modality by only 20.7% of students. Similarly, providing them with atlases for referring side by side was perceived as the favoured modality by only 17.4% of the students.

Regarding the outcomes of modified dissection hall experience, the most important factors which helped the students to get engaged are excitement to see new structures (67.8%) and interacting with faculty instructors (66.1%) to enrich their knowledge gained from lectures. Millennial student value educators who are highly relatable [21] and rapport appear to be valued more highly than an educator's knowledge or content expertise [26]. Thus, the learning outcome which is mostly valued by students isn't surprising. This was followed by quest for acquiring dissection skills and tactile/kinaesthetic learning, which is similar to a previous study which postulated that dissection course enhanced three-dimensional orientation, dexterity [27]. Learning by interacting with peers can be equated with professional competencies such as team work skills [28] and this in addition with learning new content followed in the frequency of learning outcomes of students. Applied anatomical knowledge is another learning outcome and we suggest that, modern anatomy courses should incorporate problems from diagnostic imaging and surgery which not only makes anatomy inter-disciplinary but also reflect true-to-life medical practice [29]. Despite accomplishing all positive outcomes, only few (27.3%) students were able to meet the objectives displayed. This could be well explained by the fact that students are completely engaged in multiple ways for entire two hours and therefore, the time available for sole dissection is compromised.

One of the dreaded challenges of using multiple modalities in the prescribed space and time was that students might face an increase in the extraneous cognitive load [30]. But, as the same content is displayed in a spatial and temporal unified approach using multiple formats and as students were given the choice of utilizing the resources according to their learning preferentiality, we perceive that the modified dissection hall wouldn't pose any abnormal increase in the cognitive load. On other hand, since multiple approaches are adopted the intrinsic cognitive load of anatomy due to the complexity of structures got resolved due to a greater extent.

LIMITATION

With well-planned measures and coordination offered by the faculty instructors we could execute the modified dissection hall teaching according to the FAIR principles of learning. However, it was subjected to few contingency factors such as inappropriate preparation of projected learning content at few instances, packed curriculum during abdomen and pelvis regions, hiccups in the transportation of students from one area to other.

The data generated over here gives only the preliminary evidence for the effectiveness of modifications made in the dissection hall and further extensive studies based on correlation of learning styles of students and preferentiality would be made in the future. We obtained the data during the orientation program regarding the learning styles but as it was mostly multimodal, exact correlation would not provide conclusive results. Further, we would try to assess the level of cognitive load posed by the methodology subsequently. The feedback part of the FAIR principles, despite being executed in a rigorous manner could not be evaluated for its effectiveness as we had concentrated on the cognitive and attitudinal learning outcomes of dissection hall, as such.

CONCLUSION

Inclusion of alternative methods is recommended in the process of fortifying the dissection experience and this would cater for the diversity of students who often have different learning styles. In the process of creating an enriched learning environment, anatomists should try to generate instruction methods which are relating to the learning expectations of students, highlighting the relevance in contexts simulating clinical situations and, in this process, innovation should take place within the prescribed space. By titrating the available time in the dissection hall and trying out new strategies, we could nevertheless, make anatomy more appealing and applicable for tomorrow's doctors.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Professor, Department of Anatomy, Pondicherry Institute of Medical Sciences, Puducherry, India.
2. Assistant Professor, Department of Anatomy, Jawaharlal Institute of Postgraduate Medical Education and Research (JIPMER), Puducherry, India.
3. Professor, Department of Anatomy, Pondicherry Institute of Medical Sciences, Puducherry, India.
4. Professor and Head, Department of Anatomy, Pondicherry Institute of Medical Sciences, Puducherry, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. V Dinesh Kumar
Assistant Professor, Department of Anatomy PIMS, Ganapathychettykulam, Puducherry, India.
E-mail: dinesh.88560@gmail.com

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