

## Promoting Active Learning in Respiratory Physiology – Positive Student Perception and Improved Outcomes

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### ABSTRACT

**Background & Objective:** Active learning strategies are much better recalled, enjoyed and understood. This article reports the design and evaluates on the student's experience of lectures which included many opportunities for active involvement through various active learning strategies.

**Materials and Methods:** Active learning strategies were incorporated in almost every lecture of Respiratory Physiology for first year medical students. Several techniques like think-pair-share, pause procedures, minute papers, and discussion of MCQs, concept understanding by use of models, role plays, seminars, and working on mannequins were incorporated into the lecture format.

**Results:** To evaluate the affectivity of this pattern of learning, respiratory physiology test marks of the active learning batch were compared with the previous batch of traditional learning group. Mean respiratory physiology test marks on an identical test, showed significant increase ( $p < 0.05$ ) in the active learning cohort in comparison to the previous batch of traditional learning cohort. Feedback questionnaire regarding their experience during active learning was administered to the students. The data was evaluated and analyzed. The overall feedback revealed that the active learning strategies helped the students in better understanding (94.1%), lead to greater interest (89.4%), better interaction among peers (83.6%) and also helped in correlating the topic to clinical content (80.5%).

**Conclusion:** The heightened interest, understanding and interaction engaged students in the learning process. Adopting a variety of teaching-learning methods increased both teacher and learner enthusiasm. The study provides motivation to redesign our teaching strategies to encourage greater active learning among students.

**KEY WORDS:** Active Learning Strategies; Think-Pair-Share; Pause-Procedure; Minute Papers; Feedback Questionnaire

## INTRODUCTION

Learning is not a spectator sport. Students do not learn much just by sitting in class listening to teachers, memorizing repackaged assignments and spitting out answers. They must talk about what they are learning, write about it, relate it to past experience, and apply it to their daily lives.<sup>[1]</sup> Active learning is generally defined as any instructional method that engages students in the learning process. Active learning requires students to do meaningful learning activities and think what they are doing.<sup>[2]</sup> Active learning is a learning environment that allows students to talk, listen, read, write and reflect as they approach the course content through case based studies, informal small groups, simulation, role plays and other activities. The curriculum is packed and leaves little time for students to acquire a deep understanding of the subject or to develop life-long skills such as critical thinking, problem solving, and communication. Therefore as teachers, we should unpack the curriculum and help students become active, independent learners and problem solvers.<sup>[3]</sup> It also becomes important for the teacher to create student interest and open up their minds to lifelong learning.

Active learning strategies reach to all type of learners. According to VARK learning style, learners can be identified by whether they have a preference for visual learning, auditory learning, reading and writing or kinesthetic learning. Baykan and Nacar reported that 63.9% students exhibited multimodality, indicating that they prefer a combination of learning styles, when learning information.<sup>[4]</sup> Rao and Di Carlo used a number of active learning strategies to teach respiratory physiology and concluded that it improves performance in the exams. With active learning strategies visual learners are targeted by presence of models and demonstrations. Auditory learners are reached through discussions during peer instructions, debates and games. Manipulating models and role playing satisfies kinesthetic and tactile learners.<sup>[5]</sup> We must make learning fun, because if we are

successful our students will be impatient to run home, study and contemplate to really learn.<sup>[6]</sup>

Active learning processes are becoming increasingly available, to bridge these gaps in the developed world and it should be encouraged and sustained, even as world becomes a global village.<sup>[7]</sup> A variety of teaching methods and styles encourage adaptability and lifelong learning in the teaching-learning process.<sup>[8]</sup> Involving the students actively during the lecture time, the traditional lecture format is enhanced and is regarded as more effective teaching / learning tool.<sup>[9]</sup> The use of innovative techniques requires time, planning, a commitment to the teaching process and a belief that the resulting learning will be both enjoyable and productive.<sup>[10]</sup>

Research has shown that traditional lecture method, where the teacher speaks and students listen, dominate the scene in most of the medical colleges, in India. It is therefore important to sensitize the faculty and students to the nature of active learning and get their feedback on the different strategies used and the effectiveness of these strategies. The present study to promote active learning in respiratory physiology is an endeavor on this front. The main objective of the study was to create a vibrant atmosphere in the class that will increase interactivity among students, increase interest and understanding and help them to correlate principles of respiratory physiology into clinical content.

## MATERIALS AND METHODS

Approval was taken from the research and ethical committee of the institute, before start of the project. The faculty and students were sensitized to active learning principles and activities to be carried out. Informed consent from students was taken, in this regard.

The respiratory component of medical physiology class, presented to 100 first year medical students consisted of 25 classes of 60 min each and 5 demonstration classes of 110 min each. Various active learning strategies were

incorporated in all classes, one at a time. Though subsequently multiple modalities were used depending on the topic of the lecture. The active learning techniques included were –pause procedure, minute papers, think-pair-share, working with models, answering MCQ's using colored chart slips, presentation of seminars, short home assignments and role plays.

The class was divided into small groups of 4 students each. Students were given a few minutes at the beginning of every lecture to rearrange their seats according to their groups. Groups were formed because many of the active learning strategies used were group activities. The students in each group worked together, discussed things together and motivated each other.

**Pause procedure, Minute papers, Think-pair-share** activities were introduced during the lectures; this helped students to interact and reflect back on what they had studied and inferred during the lectures.

**Pause procedure** - Keeping in mind the human attention span, the lecture was punctuated every 15-18 min for 1-5 minutes. The students were asked to do something else, reflect on their notes, discuss in their groups and ask questions. It was used in conjunction with minute papers.

**Minute papers** - Students were asked about what was the most important thing they learnt in the class, what was confusing about the lecture and what they would like to learn more.

**Think-pair-share** –Since students were seated in teams of 4, they were given numbers from 1 to 4. Student 1 and 2 were asked to pair, at the same time student 3 and 4 were to discuss together. Students were posed a question, time was given to think the answer, discuss in their group and share it when asked. Any doubts regarding the concepts were also cleared during this time.

Certain concepts of Respiratory physiology were explained using **Models**. Simple models were prepared to make the students understand the

concepts of mechanics of respiratory physiology and alveolar ventilation. The models were designed to help students understand, the cohesive forces of the intrapleural pressure, chest wall and lung dynamics, alveolar volumes and regional differences in ventilation. Students were encouraged to manipulate models to enhance their understanding on how they work. The models were prepared by the teacher and the students as explained by Stephen di Carlo in his paper.<sup>[11]</sup>

**MCQs** (one best answer out of four) were discussed at the end of every chapter to have better understanding of the topic. Four different colored play cards were given to each group (one color for each correct answer). The response to each MCQ was given by each group after discussion with their group members by holding the colored card relating to their answer.

**Seminars** were presented by volunteer students on various topics relating to physico-clinical aspects of respiratory physiology, like – dyspnoea, apnoea, breath holding, asphyxia, drowning, periodic breathing etc. This exercise built up the enthusiasm and urges to learn more. Short **Assignments** were given to students to work at home and discuss the other day in the class. One assignment was on a case relating to carbon monoxide poisoning, another assignment was a case of respiratory alkalosis. In another assignment, spirometry graphs of patients of restrictive and obstructive diseases were given to students and they were asked to comment on them.

A few **Role plays** were introduced to create interest and deeper understanding of certain important aspects. The role plays were designed on doctor patient relation on history taking in respiratory physiology and performing spirometry on two different patients with restrictive and obstructive diseases. Role plays were also designed to demonstrate Heimlich maneuver, Holger Neilson method and Cardio-respiratory resuscitation. This helped in bridging the gap between theory and practice in earlier years of education.

**Mannequins** were used for practical experience of Cardiopulmonary resuscitation (CPR). In fact a role play was designed to understand the finer aspects of CPR.

To compare the effectiveness of active learning strategies for first year medical students, we compared the respiratory physiology test marks (formative assessment), obtained by students of previous batch, who were taught by tradition method (Group1) and the present batch who were taught using active learning strategies (Group 2). An identical test was administered to both the groups. The test was of 50 marks each, having 12 marks MCQs and 38 marks short structured questionnaire.

A feedback questionnaire based on five point likert scale was administered to the students after completion of the project. It consisted of both closed and open ended questions. Feedback from students was compiled and analyzed by frequency analysis.

## RESULTS

Table1, presents the mean  $\pm$  SD of the marks obtained by Group1 (Traditional group) and Group 2 (Active learning group). The mean percentage and standard deviation of correct answers for Group1 (n= 94) and for Group 2 (n= 97) was  $26.0106 \pm 9.70256$  and  $29.4227 \pm 8.66487$  respectively. Un-paired t-test was used to evaluate differences on the tests in both the groups. The test revealed that students of active-learning group performed significantly better ( $P < 0.05$ ) than the students of traditional group on identical test (Table1).

The results of the Student feedback questionnaire response are given in Table 2. The responses are expressed in percentage. The response to most of the questions was positive. Specific comments and suggestions of students were favorable. Table 3, represents the bar graph representation of the student feedback questionnaire response.

Analysis of the questionnaire of close ended questions from student feedback revealed that

most of the students agreed that active learning strategies helped them to create interest (89.4%) and better understanding (94.1%) about the subject. 80.15% of students felt that correlation of concepts was better. 83.6% felt there was better interaction among students. Most of the students agreed that Models (98.8%), Role plays (98%), MCQs (92.9%), Minute papers (94%) and Pause procedures (82.5%) helped in better understanding of the concepts.

The open ended question generated some interesting facts. Most of the students were of the opinion that group discussions gave them an opportunity to talk and share their views with their peers in the class itself. Working on assignments in groups made them more responsible for themselves and each other. The students really enjoyed the whole concept and were keen to study whole of physiology with active learning strategies. They liked the instant reviewing in the classes. The students from other countries studying in the class were especially happy with the concept. They found the respiratory practical classes cheerful and role plays and working on mannequins fun.

Few comments and suggestions from the students are as under-

- They demanded more lectures for respiratory physiology, also demanded to incorporate active learning strategies in other topics of physiology. They preferred group presentations during seminars to be cross questioned, 5 min written test before each lecture and addition of short quizzes. They felt the teacher was like a friend, the practical classes were cheerful, role plays on CPR, doctor-patient role play and role play on Hemilich's, maneuver were fun. Most helpful and interesting for them were MCQs and working on Models. The international students felt that the teaching was, "Totally American style and instant reviewing was the best".
- There was also a very positive feedback from the faculty of the department and some of the other faculty in the institute.

**Table-1: Marks Obtained by Two Batches of Students in Respiratory Physiology Test**

Groups	No. of Students (n)	Marks (MM = 50) Mean ± SD	SEM	t - value	p - value
Group 1 (Traditional learning group)	94	26.0106 ± 9.70256	1.00074	2.565	0.011 Significant
Group 2 (Active Learning group)	97	29.422 ± 8.66487	0.87978		

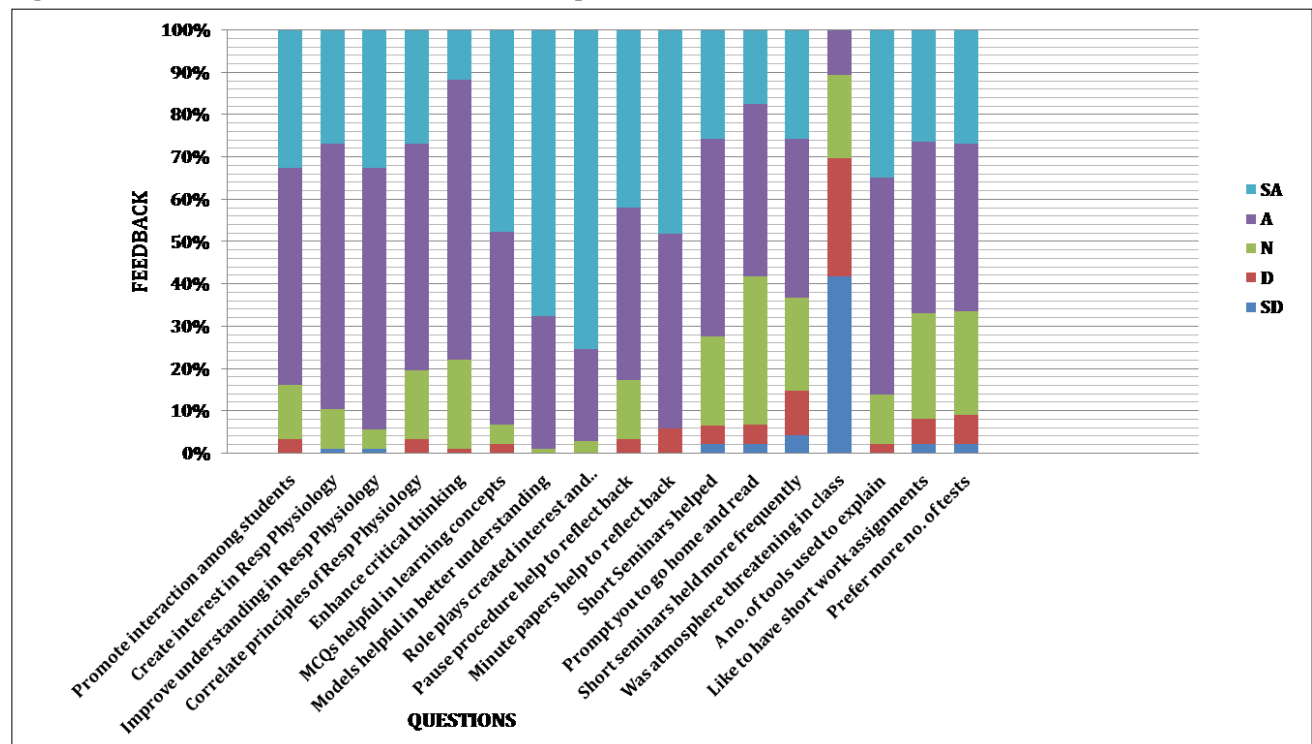
P < 0.05 = significant

**Table-2: Student Feedback Form (Result in Percentage)**

No.	Questions	SA	A	N	D	SD
1	Did the lectures create interest in Respiratory Physiology	26.7	62.7	9.3	0	1.1
2	Did the lectures improve understanding in Respiratory Physiology	32.5	61.6	4.65	0	1.1
3	Where you able to correlate principles of Respiratory Physiology into clinical content	26.7	53.4	16.2	3.4	0
4	Where you able to enhance your critical thinking	11.6	66.2	21	1.1	0
5	Did the lectures prompt you to go home and read	17.4	40.7	34.8	4.6	2.3
6	Did it promote interaction among students while discussing concepts in groups	32.5	51.1	12.8	3.4	0
7	Did the pause period help you to reflect back on the concepts	41.8	40.7	14	3.4	0
8	Did the minute papers help you to reflect back on the particular lecture	48	46	0	6	0
9	Where MCQs asked by using diff colored cards helpful in learning concepts	47.6	45.3	4.65	2.3	0
10	Did the models help you in better understanding of the concepts	67.4	31.4	1.1	0	0
11	Did the role plays create interest and understanding of certain aspects	76	21	3	0	0
12	Did the short seminars help esp students who presented them	25.6	46.5	21	4.4	2.2
13	Should seminars by students be held more frequently	25.6	37.2	22	10.4	4.4
14	Would you like to have short work assignments to increase your knowledge of the concepts	25.6	39.5	24.4	5.8	2.2
15	Would you prefer more no. of tests	26.7	39.5	24.4	7	2.2
16	Were a no. of tools used to explain the concepts	34.8	51.1	11.6	2.3	0
17	Was the atmosphere threatening in the class	0	10.46	19.76	28	41.8

SA= Strongly Agree, A= Agree, N= Neutral, D= Disagree, SD= Strongly Disagree

**Figure-1: Student Feedback Questionnaire Response**



SA= Strongly Agree, A= Agree, N= Neutral, D= Disagree, SD= Strongly Disagree



## DISCUSSION

In this study we incorporated active learning strategies in traditional lecture format and tried to find out its effectiveness by evaluating the student responses to the feedback questionnaire, on a 5 point likert scale and the marks they obtained in respiratory physiology test.

Studies in education have demonstrated that increased attention and motivation enhance memory.<sup>[12,13]</sup> Active participation and involvement is a prerequisite for learning beyond the recall of facts, and the students must be attentive and motivated in order for learning to occur. Educational research has shown that students who are actively involved in the learning activity will learn more than students who are passive recipients of knowledge.<sup>[9,14]</sup> Similar study by Rao and DiCarlo used various active learning strategies to teach respiratory physiology. They concluded that by actively involving students in the learning process, academic performance is enhanced.<sup>[5]</sup> By actively involving students in the learning process, they are more likely to undertake a deep approach to learning and improve their academic performance.<sup>[1]</sup>

The importance of feedback to learning has been frequently noted. Active learning allows teachers to receive feedback on student's needs and perceptions, and on future teaching- learning directions.<sup>[15]</sup> The close and open ended questionnaire feedback of the students throw a light on the students perception on the strategies used and also gave an insight to their learning needs. Analysis of the questionnaire of student feedback revealed that most of the students agreed that active learning strategies helped them to create interest (89.4%) and better understanding (94.1%) about the subject. 80.15% of students felt that correlation of concepts was better. 83.6% felt there was better interaction among students. Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking.<sup>[16]</sup> These

activities also promote working in groups and generate high levels of motivation and enthusiasm.<sup>[17]</sup> For medical students, who will always be working in team environments, these learning experiences are invaluable.<sup>[4]</sup> Although breaking the class into small groups is a very effective technique, it is not frequently attempted because of the noise created while discussions in these 'buzz groups'. However, if the teacher is 'in control', this strategy will seem to have a distinct advantage over traditional lecturing.

Collaborative-learning exercises, pause procedure, think-pair-share, minute papers, role playing, models, seminars, case based studies are active-learning strategies that can be used effectively in large classrooms. An advantage of these procedures is that they require little preparation. The students get time to reflect back, discuss in their groups and delve deeper into the material.<sup>[18]</sup> The one-minute paper has been subjected to rigorous empirical tests, and its daily use has been found to increase student knowledge significantly.<sup>[19]</sup>

There has been plenty of evidence that most students preferred multiple modes of information and the first year medical students prefer multiple learning styles.<sup>[4,20]</sup> Simple inexpensive models encourage research oriented learning and help students to understand complex ideas. The models provide elements of surprise, students are drawn into discussion. Active participation with physical models can reach all types of learners via visual, auditory, kinesthetic and tactile schemes of learning.<sup>[11,20]</sup> Role plays are valued by students in the acquisition of communication skills. They are effective, economical and easily reproducible.<sup>[21]</sup> Guidelines for effective role-play include adequate preparation, alignment of roles and tasks with level of practice, structured feedback guidelines and acknowledgment of the importance of social interactions for learning.<sup>[22]</sup> MCQs can be asked in the class using Personal Response system. In the absence of this system we used colored cards for students to answer questions. It increased student engagement, the feedback to the student and the teacher was

immediate. The students came to know the correct response and the teacher had an idea about the aspects of the topic that were still unclear to most of the students. Many medical institutes are using the personal response system to increase active participation of the students.<sup>[23]</sup> Seminar learning was well accepted by the students and there was eager participation of about twenty students. An earlier study finds the evidence that most aspects that affect seminar learning are consistent with aspects affecting small group learning. Course schedule and alignment seem to have a stronger impact on seminar learning.<sup>[24]</sup>

The initial impact of the study has been reflected in the form of increased demand for lectures for respiratory physiology. The students also requested to incorporate active learning strategies in other topics of physiology. Also, it was accepted by other faculty members of the same as well as other departments, as was evident by their effort ensuring use of some of the strategies in their own lectures.

This study has its limitations. Time is one big limiting factor. Practical problems like time constraints, adjustment of lectures and scheduling of activities is slightly difficult. We overcame the time constraints by meticulously planning the activities. We requested the department of Anatomy and Biochemistry and borrowed their lectures. We also took some extra lectures during the physiology demonstration time; whenever it was possible. Students who had difficulties were given extra time after the college hours, since the daily time-table of the class is tightly packed.

## CONCLUSION

The study to promote active learning helped create a vibrant, interesting and interactive atmosphere in the classroom. Students have benefitted from the increased variety of learning activities and resources by utilizing additional learning styles. The student feedback to active learning strategies was very positive. They highly appreciated the use of models, role plays, minute papers, MCQs using colored cards. Active learning strategies work better than passive

approaches because student's participation in the learning process is ensured. The positive inputs from other faculty members in the department ensured use of some active learning techniques by many of them. At the same time active learning has practical problems like time restraints and commitment. Also constant effort is required to carefully plan the activities, to meticulously plan when and where to use them and also to ensure student participation. The hard work by the teacher will always be rewarding. We as teachers should keep on modifying our teaching, according to our own style and student requirement.

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