

## ORIGINAL ARTICLE

## LEARNING OF ECG WITH PUZZLES

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**Background:** The students learn effectively well with active learning strategies as compared to traditional approach. The objective of present study was to evaluate the effect on learning outcome of post lecture puzzles. **Method:** This study was carried out on 1<sup>st</sup> year medical students. Initially a lecture on ECG was given. At the end of lecture, assessment of students was done. On the second day whole class was divided into 6 groups, each group comprising of 12–15 students. Each group was provided with an illustration of ECG waves, cardiac vectors, and ECG leads, and were asked to recognize and label those with chips. At the end of this puzzle, assessment of students was carried out by fill-in-the-blank questions. At the end students' feedback was taken. **Results:** For ECG, pre puzzle and post puzzle scores of participants were  $5.23 \pm 2.06$  and  $6.70 \pm 2.27$  out of 10 respectively. In feedback 79.5% expressed that it was useful for their better comprehension, 9.6% said that it was necessary and 10.89% students responded that this activity was not necessary but was useful. The passing percentage of Islamic International Medical College improved by 23.1%. **Conclusion:** Post lectures puzzles can lead to better learning outcome. It was well appreciated by the students.

**Keywords:** ECG, puzzles, quizzes, questionnaire

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## INTRODUCTION

Medical educators are committed in preparing future healthcare providers but are faced with the challenges in transmitting the ever-expanding knowledge to their students. Recognizing student learning styles, educators are able to build a better framework for more efficient and desirable teaching methods. Learning is an active process. Most students learn effectively well if instructor provides information in activities like interactive teaching, visual, auditory, reading/writing and kinaesthetic learning, (from touch, hearing, smell, taste and sight). For this purpose role playing, simulations, models, debates and games are active strategies that can be used in class as well as small groups.<sup>1</sup> Teaching in relation to any topic requires considerable creativity and imagination in order to capture and retain the interest of students/learners.<sup>2</sup> Compared to traditional approaches active learning activates creativity and imagination resulting in more deep understanding in the students.<sup>3</sup> Hospital wards can be taken as a good example, of enhanced learning for the nursing students as they learn by direct experiences with the patients. These wards bridge the gap between theory and clinical skills of the students.<sup>4</sup>

Physiology deserves a prominent place in today's undergraduate curriculum, because it is one of the few courses of instruction that specifically prepares its students' minds to make connections among disciplines.<sup>5</sup> In first year medical students, while teaching renal physiology, it was observed that if a faculty member interacts with a small group of students and discusses clinical cases through active learning exercises, then he can achieve a noticeable increase in student satisfaction and enhance their learning.<sup>6</sup> Even

voluntary participation of the students in an active learning exercises enhances students learning because it shows genuine interest to understand the basic mechanisms involved in Physiology.<sup>7</sup> Physiology is one of the disciplines that involves memorization of the terminologies along with concepts that should be crystal clear<sup>8</sup>, as according to one researcher "Physiology is the branch dedicated to proliferation of terminology".<sup>5</sup>

Most medical professionals are expected to possess basic electrocardiogram (ECG) interpretation skills. But published data suggests that residents' and physicians' skills to interpret ECG are suboptimal. Learning styles differ among medical students; individualization of teaching methods has been shown to be viable and may result in improved learning. Puzzles have been shown to facilitate learning in a relaxed environment. Some researchers have used games based on the format of trivial pursuit to understand cardiovascular Physiology<sup>9</sup> but one of limitations of this approach was that it requires software which most medical schools may not have and it needs expertise both for the students and facilitator(s) to run such games. Some researchers used puzzles to teach cardiac cycle but they did not assess the students learning both pre puzzle and post puzzle.<sup>10</sup>

The present study is an attempt to bridge this gap by giving puzzles of ECG to the students in small groups after the whole class lectures of these topics and we assessed students both pre and post puzzles. Students' feedback has been the tool to assess their level of satisfaction or comments to improve the process further. In this way it was a double effort for the better understanding of students.

## MATERIAL AND METHODS

Ethical approval of the study was taken from Ethics Review Committee of Riphah International University. The study was carried out at Islamic International Medical College (IIMC) Rawalpindi and Rawal Institute of Health Sciences (RIHS) Islamabad between August 2014 and October 2015. The time for lectures in which study was carried out was not specially arranged, instead these lectures were already present in the regular timetable of teaching module of Cardiovascular Physiology of 1<sup>st</sup> year MBBS.

Out of 100 students, eighty-one (81) 1<sup>st</sup> Year MBBS students of Islamic International Medical College and 75 1<sup>st</sup> year MBBS students from Rawal Institute of Health Sciences voluntarily participated in the study. It was a simple random sampling technique. First of all a lecture on ECG to the whole class of 1<sup>st</sup> year was given by senior instructors though by different lecturers in both medical colleges. The lecture was given in the presentation form displaced on audio-visual multimedia. The duration of lectures in each medical college was 50 minutes for one lecture. The Physiology of ECG was taught in two lectures, each lecture on consecutive days.

At the end of the second lecture a question paper for assessment of learning, containing 10 fill-in-the-blanks questions about ECG was given to the students. Each question carried 1 mark. It was filled by the students on the same day. On the next day students were divided into 6 groups, each group comprising of 12–15 students. Group leaders for every group were selected by the students who were responsible to maintain the group dynamics though instructors were present all the time in activity area. Each group was given a printed coloured illustration on standard chart paper of complete ECG. Each group was given ten minutes to discuss these illustrations. They were supposed to recognize direction of current flow during the process of depolarization and repolarization of atria, parts of conducting system of heart and ventricles.

To represent vectors of depolarization and repolarization in heart, arrows of hard chart paper were cut in different length and width. The concept behind different length and width of arrows was basically due to different voltages of impulses conducted in atria, AV node, interventricular septum, apex of the ventricles, and base of the ventricles. After discussion students had to place these cards paper vectors on representative areas of heart on illustration, the arrow head showing the direction of impulse conduction. After completing first puzzle another illustration of ECG leads was given. After a discussion for 10 minutes on placement of ECG leads on human body, students had to place positive or negative written chips of different ECG leads on the right box of the illustration of chest leads. After that

they were provided with third puzzle that contained a drawing of normal ECG on chart paper. ECG drawing was labelled with chip number. Again 10 minutes were given to each group for discussion to identify the waves and segments of the ECG.

After that, students' had to fill the columns in which first column was already filled and other two columns for chip number and waves of the ECG were left blank. Students were allowed to freely interact with each other for all three puzzles in the presence of two trained instructors. The completed puzzles were checked by instructors and if correction was required it was explained to students and then was done by the students themselves. After the activity of puzzles a question paper though different from the first, with same level of difficulty containing 10 fill-in-the-blanks questions on ECG was given to the students. This was post puzzles assessment. It was followed by taking feedback from students regarding usefulness of the activity.

The data was analysed using SPSS-23. The mean and standard deviation of learning outcome of pre puzzle and post puzzle was analysed by paired samples *t*-test. The frequency and percentage of pass/fail students in pre puzzles and post puzzles tests were compared through chi-square test, odds ratio was calculated by selecting risk in cross tabs in descriptive statistics, and  $p < 0.05$  was taken as statistically significant.

## RESULTS

Table-1 shows comparison of mean scores between pre and post puzzles. The mean differences were significant ( $p < 0.001$ ) between the pre- and post-puzzle scores. Table-2 shows comparison of frequency and percentage of students who passed or failed in pre- or post-puzzles exams along with statistical significance and Odds Ratio. The mean differences were significant ( $p < 0.005$ ) between the pre- and post-puzzle scores. The feedback from the students is tabulated in Table-3. Majority (79.5%) of the students opined that the method was useful for his/her learning process.

**Table-1: Comparison of pre and post activity scores**

Exam	Exam score (Mean±SD)	<i>p</i>
Pre-puzzle	5.23±2.06	<0.001
Post-puzzle	6.70±2.27	

**Table-2: Frequency comparison of students who passed and failed pre and post puzzle exams**

		Post-puzzle		Total	<i>p</i>	Odds Ratio	
		Pass	Fail				
Pre-puzzle	Pass	Count	95	11	106	<0.005	3.36 (1.40–8.08)
		% of Total	60.9	7.1	67.9		
	Fail	Count	36	14	50		
		% of Total	23.1	9.0	32.1		
Total	Count	131	25	156			
	% of Total	84.0	16.0	100			

**Table-3: Feedback of students regarding learning of ECG of with puzzles (n=156)**

Response variable	Frequency	Percentage
Not necessary but was useful	17	10.89
Useful for my better comprehension	124	79.5
It was necessary	15	9.6

## DISCUSSION

This study shows the effect of post lecture puzzles on the same topic in learning Physiology. The mean score of exams of all the students improved after they actively participated in puzzles and this comparison was statistically significant. The pass/fail comparison of pre- and post-puzzle was also interesting; 23% of the students who failed in pre-puzzle test were able to pass the post puzzle test which was statistically significant. The odds ratio also showed that the chance of passing becomes more than three times after puzzles. Most of the students gave feedback that the puzzles were useful for their better comprehension of learning content of ECG.

Educational games provide learning opportunity with entertainment along with improvement in decision making and problem solving in active learning environment. Educational games are perfect tool for transmitting information in an attractive and efficient way.<sup>11</sup> This activates higher thinking like analysis, synthesis, and evaluation thus making learning more exciting and reducing stress and anxiety.<sup>12-14</sup>

It is essential to incorporate student involvement called, active learning into traditional teaching which ultimately stimulates students intellectually and promotes better learning.<sup>15,16</sup> Passive learning in Physiology most of the times results in misconception in the students especially in classroom, until and unless these misconceptions are cleared, they remain in the students mind. One way to clear these misconceptions is to ask students to voluntarily participate in the learning process and to teach them with games or puzzles.<sup>6</sup>

This study also confirms the difficulty of understanding basic ECG Physiology in medical students, as even with combined effort of lecture and ECG puzzles, the students scored 6.7 marks out of 10. This study is comparable to another similar study carried out in USA in understating the ECG in medical students that showed a score of 6.5 out of 10 even after combined teaching modality.<sup>17</sup>

There was an improvement in understanding and performance of the students after ECG puzzles. It shows that if students are given free hand to solve a case in the presence of a senior instructor their learning improves. In this exercise, peer discussion was allowed and students did discuss with each other prior to filling the illustration. The passing percentage of students improved significantly which could be due to increased level of interest in puzzles because lectures most of the

time become passive as compared to puzzles which are a part of active learning. A study carried out in Australia showed similar results as students valued lectorials (A combined teaching strategy of lecture and tutorial) and showed deep interest and also improved learning outcome.<sup>18</sup>

In this study almost 79.5% students gave feedback that this activity was necessary for their better comprehension of Physiological mechanisms of formation of ECG waves and intervals. In Brazil a study was carried out on learning of cardiac cycle by puzzles after a lecture, almost 64.5% of the students in that study gave feedback that puzzles after a conventional lecture were helpful in understanding the basic concepts and to clarify the different items.<sup>10</sup> In present study ECG was used as learning tool.

The limitation of this study can be sample size as better results could be obtained from larger sample size. Another limitation can be that the students of other disciplines, other than MBBS should also be involved.

## CONCLUSION

Combined teaching method, like lecture followed by puzzles, improved the understanding of the ECG in medical students. It may be particularly useful for students that may learn more efficiently in relaxed environments that are more learner-centred.

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