



## A comparison between peer-assisted learning and self-study for electrocardiography interpretation in Thai medical students

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### Abstract

**Introduction:** Peer-assisted learning has been shown to be an effective teaching and learning method. However, this technique has not been proven in Thai medical school. We aimed to compare the effectiveness of peer-assisted learning and self-study in interpreting an electrocardiogram in Thai medical students.

**Methods:** This is a prospective, randomized controlled trial, conducted in Chonburi teaching hospital, a community hospital affiliated with Chulalongkorn University. All medical students from the fourth and fifth years, a total of eighty students, were randomly assigned to two groups of peer-assisted learning (PAL) and self-study (SS) via stratified randomization done by computer-generated randomization. The two groups were matched for sex and grade point average. In the PAL group, teaching was performed by the fourth and fifth year medical students. We conducted five weekly study sessions. Different topics of electrocardiogram interpretation were assigned to tutors for teaching. SS group would separately study the same topic on their own. Constructed response questions were used to assess the students at the beginning as a pre-test and after a five-week session as a post-test. Online self-assessment was delivered to students one month after the study.

**Results:** Mean pre-test and post-test score was put into the analysis and compared across groups using t-test. No significant difference in pre-test score was observed between the two groups in the same academic year. There was a significant difference between the mean post-test score between the fourth year PAL and SS groups. Also, the mean difference score in the fourth year PAL group was higher than the fourth year SS group. However, in the fifth year group, there was no significant difference between the PAL and SS groups in the mean post-test score and mean difference score.

**Conclusion:** In conclusion, peer-assisted learning is an interesting method to improve understanding and interpreting skills of basic ECG better than self-study in the early clinical year medical students.

**Keywords:** Peer group; Electrocardiography; Self-assessment

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## Introduction

Electrocardiogram (ECG) interpretation skill is essential for all physicians. Detecting the common abnormalities and life-threatening conditions has become a basic requirement for undergraduates and has been taught throughout medical schools for years (1). However, many medical students, junior physicians or even residents still have difficulty interpreting the ECG (2-4). Though many recent and advanced ECG machines are capable of providing computerized interpretation, results cannot be relied on and still needs to be reviewed by human doctors (5-7). Although there are various methods of teaching and learning ECG, a review study has shown that there is currently no single method of ECG teaching that is the most effective one. Each method has its own advantage and disadvantage with varying efficacy, such as web-based learning, self-directed learning or self-study (SS), and workshop-based teaching (8).

Peer-assisted learning (PAL) is another way of teaching in medical education (9). This method can be defined as “the acquisition of knowledge and skill through active helping and supporting among peers or matched companions. It involves people from similar social groupings, who are not professional teachers, helping each other to learn and learning themselves to do so” (10). There are many proven benefits of this method. For example, participants were found to have prominent improvement in several learning areas, including cognition, psychomotor, affection, and confidence. These improvements are due to the relaxing environment, the interaction between the teachers and learners, and the retention process acquired during individual preparation prior to the teaching session (9, 11-13). Several previous studies reported many benefits of PAL. This method was proved to be as equally effective, if not better, as self-study across many levels of medical education and medical professionals (14, 15). A recent scope review by Williams et al. identified at least 10 studies that reported positive outcome on PAL (16). de Silva et al. also showed that PAL could be used to effectively encourage medical students and improve their study hours (17). Rengier et al. demonstrated that even short-term use of PAL could help the students to perform better on their exams (18). For procedural skills, Knobe et al. and Tolsgard et al. reported that PAL could be used to improve ultrasound and bladder catheterization using skills, respectively (19, 20). A larger retrospective study by Iwata et al. also showed similar results, indicating that PAL can be used to improve obstructive structured clinical examination (OSCE) score (21). The benefit

of PAL can also be seen even in postgraduate clinical trainees as well (22). However, Williams et al. reported that several studies did not show benefit of PAL, when compared to conventional self-study (16). Moreover, PAL is not yet to be evaluated as an effective way of learning ECG, especially in Thai medical schools.

The purpose of this study is to support the notion that, among Thai medical students, peer-assisted learning is more beneficial than self-study when it comes to the apprehension and interpretation of common ECG abnormalities.

## Methods

We performed an experimental study at Chonburi teaching hospital, which is a large community hospital affiliated to Chulalongkorn University. The process consisted of one hundred and twenty medical students, with forty medical students each from the fourth, fifth and sixth years. The study was conducted from September 2016 to January 2017. Convenience sampling method was used to select the participants. Despite the aim of having as many students enrolled as possible, most sixth year students were preparing for their license examination. Thus, we included every student on the fourth and fifth years and the number of participants was limited to eighty. Every student was at the beginning of his/her academic year. The curriculum of the medical schools in Thailand consists of six academic years. The clinical years are the fourth, fifth and sixth years. The fourth year medical students in our study had not had any prior clinical exposure at the time of the study. However, the fifth year medical students had rotated in four rotations during their fourth year, which were internal medicine, surgery, obstetrics-gynecology, and pediatrics. The trial protocol was approved by the Ethics committee of Chonburi Hospital. All students provided written informed consent.

To randomize the participants, we performed stratified randomization method (23, 24). We separated the fourth and fifth year medical students into two groups of forty, each based on their academic year. In each group, we further separated medical students into two groups based on gender. We, then, further separated medical students into three groups based on their grade point average (GPA) of a) more than 3.60, b) 3.20 to 3.60 and c) less than 3.20. We chose these specific numbers as 3.60 and 3.20 are the minimum GPA to receive the first class and second class graduation honors, respectively. After that, students were randomized into two study groups of PAL and SS groups in a 1:1 ratio via simple randomization (computer-generated

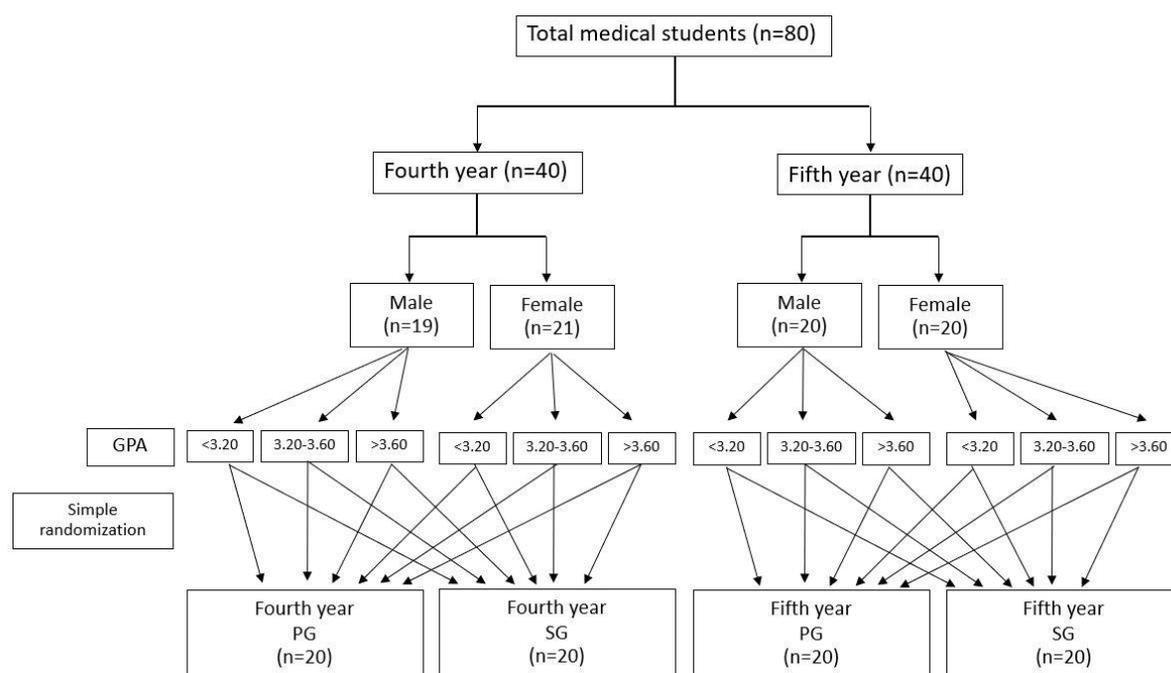


Figure 1: Randomization process

number). Figure 1 displays the randomized process. Every student was instructed not to communicate among the groups about ECG or any study-related topics after the randomization.

All students from the fourth and fifth year medical students were enrolled. A total of eighty medical students were included, forty for each academic year and randomized, as explained above. After randomization, there were four equal study groups that participated in the study separately, i.e. fourth year PAL group, fourth year SS group, fifth year PAL and fifth year SS group. At the very beginning of the study, every student took a pre-test exam consisting of ten constructed response questions (CRQs) in the topic of ECG. The details of CRQs will be mentioned later in the article. Pre-test score was gathered and recorded.

We had five one-hour study sessions weekly for every group. Each study session covered one of the five following topics:

- Basic interpretation including leads and axis
- Myocardial ischemia and infarction
- Arrhythmias
- Chamber enlargement and hypertrophy
- Effects of drugs and electrolytes

The fourth and fifth year study sessions, both SS group and PAL group, were held separately across four separate classrooms. For the PAL group, four students in PAL group were randomly selected each week to be mentors and were assigned in advance with the topics and contents to teach in that particular week. Mentorship was selected differently each week and had not have

been taught by any medical staff. Thus, by the end of the five-week study session, all students in the PAL group had their chance to be a mentor once. Exactly at the same time, the fourth and fifth year SS group students were required to study the same material as those in the PAL group on their own in another separate room. Each study period lasted for one hour, similar to the PAL and SS groups.

Throughout the five-week duration of the study, every student was continuously refrained from communication between the groups, or even within their own study group, about ECG or any study-related topics. Also, we appointed volunteer residents or attending physicians to be instructors in each study session for each group to observe and eliminate any non-instructed activities, including extra-references and non-ECG topic discussions. Instructors were there to only observe and record the time of each study session and were not allowed to answer any ECG-related question from subjects in both groups. Tutors from the PAL group and students from the SS group were provided with the same references, which were Harrison 19<sup>th</sup> edition textbook (Chapter 268 Electrocardiography (25), Chapter 269 Atlas of Electrocardiography (26)), and Braunwald's Heart Disease 10<sup>th</sup> edition textbook (Chapter 12 Electrocardiography (27)). Contents that were taught in each session in the PAL group must only come from the resource mentioned above, and students in both groups were prohibited from using any other study materials.

One week after the five-week study course finished, a post-test was held for all students. The questions used in the post-test were the same as the pre-test examination. However, students were not informed that they would have the same questions. Online self-assessment was handed to students one month after the post-test. Students were not obligated to complete this online form.

Regarding CRQs, ten questions were taken from Electrocardiography Self-Assessment Program version four (ECG-SAP 4) (28). Students would have pictures of the ECG and would select the appropriate interpretation or findings on the answer sheet. All questions fulfilled the requisite criteria as they were selected by an attending cardiologist from Chonburi Medical Education Center Thailand. All the points were graded by instructors according to ECG-SAB 4 with the maximum score of thirty points in total. Same ten ECG questions were used for pre-test and post-test.

The significant findings of the ten ECG questions were as follow:

- 1) Normal ECG
- 2) Atrial fibrillation
- 3) Atrial flutter
- 4) Left ventricular and atrium hypertrophy
- 5) Ventricular fibrillation
- 6) Wolf-Parkinson White syndrome
- 7) Hyperkalemia
- 8) Anterior wall ST-elevation myocardial infarction
- 9) Tricyclic antidepressant toxicity
- 10) Right bundle branch block.

The online self-assessment consisted of three questions. Answers were on a scale of one to five, with one being "none" and five being "the most". The questions were as follow:

- 1) Do you think the ECG classroom that you attend can improve overall ECG interpretation skills?
- 2) Does ECG classroom improve your confidence in overall ECG interpretation?
- 3) Does ECG classroom improve your performance in real clinical settings?

SPSS version 22.0 was used for statistical analyses. Independent t-test was used to analyze the differences in the continuous variables between groups. Shapiro-Wilk test was used for the test for normality. Pre-test and post-test scores were presented as mean (SD). Score from the online assessment was presented as mean. A P value of <0.05 was considered statistically significant.

## Results

A total of eighty students completed the

five-week course with no dropout. All of the students were medical students at Chonburi teaching hospital at the time of the study. Forty students were fourth year medical students and other forty were fifth year medical students. Basic characteristics of enrolled students, including grade point average (GPA) and gender, were shown in Table 1.

Mean pre-test score, mean post-test score and mean difference score were shown in Table 2. Pre-test score difference between the fourth year PAL group and the fourth year SS group, and the fifth year PAL group and the fifth year SS group were not significant. Overall mean pre-test score of the fifth year students was higher than the fourth year students. For all four groups, fourth year PAL group, fourth year SS group, fifth year PAL group, and fifth year SS group, the mean post-test score was significantly higher than the mean pre-test score. There was a significant difference in mean post-test score between the fourth year PAL group and the fourth year SS group. However, the difference of mean post-test score between the fifth year PAL group and the fifth year SS group was found to be insignificant. For mean difference score, the fourth year PAL group showed significantly higher mean difference score than the fourth year SS group. In the fifth year group, the difference of mean difference score between PAL group and SS group was not statistically significant.

Regarding online-self assessment, sixty-two (77.5%) students completed the assessment. Mean score for each question were shown in Table 3. Students in PAL group from both fourth and fifth year had higher mean score for every question compared to SS group in their respective academic year. However, the differences were significant only for the question "Do you think the ECG classroom that you attend can improve overall ECG interpretation skills?" for both years, and the question "Does ECG classroom improve your confidence in overall ECG interpretation?" for the fourth year students. The difference of mean score of question "Does ECG classroom improve your performance in real clinical settings?" was not significant in both years.

## Discussion

Self-study is a very common method used for studying medicine in Thai medical schools. While the most beneficial part of PAL involves effective communication between peers, Thai students may unable to utilize the most advantageous part of PAL due do their quiet and modest nature. We aim to evaluate whether PAL can be implemented in Thai medical schools on

**Table 1:** Characteristics of medical students participating in the study (N=80)

	4 <sup>th</sup> year PAL group	4 <sup>th</sup> year SS group	p	5 <sup>th</sup> year PAL group	5 <sup>th</sup> year SS group	p
N	20	20	-	20	20	-
Gender (Male)	9 (45%)	10 (50%)	0.751	11 (55%)	9 (45%)	0.527
Mean GPA (SD)	3.141 (0.376)	3.180 (0.330)	0.730	3.231 (0.278)	3.232 (0.322)	0.992

GPA: Grade Point Average (out of 4.00), PAL: Peer-Assisted Learning, SS: Self-Study

**Table 2:** Pre-test, post-test and difference in scores by the participants (N=80)

	4 <sup>th</sup> year PAL group	4 <sup>th</sup> year SS group	t(31), p	5 <sup>th</sup> year PAL group	5 <sup>th</sup> year SS group	t(31), p
N	20	20	-	20	20	-
Mean pre-test (SD)	7.9 (1.9)	8.7 (2.5)	$t_{(38)} = -1.15, 0.25$	12.7 (4.8)	11.7 (3.6)	$t_{(38)} = 0.71, 0.48$
Mean- post-test (SD)	17.7 (3.4)	13.3 (3.8)	$t_{(38)} = 3.91, <0.001$	19.5 (4.3)	17.3 (6.1)	$t_{(38)} = 1.33, 0.19$
Mean difference Score (SD)	9.8 (3.3)	4.6 (3.7)	$t_{(38)} = 4.70, <0.001$	6.8 (4.4)	5.6 (5.5)	$t_{(38)} = 0.80, 0.43$

PAL: Peer-Assisted Learning, SS: Self-Study

**Table 3:** Online self-assessment questions answered by the participants (N=62)

	4 <sup>th</sup> year PAL group	4 <sup>th</sup> year SS group	p	5 <sup>th</sup> year PAL group	5 <sup>th</sup> year SS group	p
N	17	15	-	13	17	-
Mean score of Question 1 (SD)	3.47 (0.51)	3.13 (0.35)	0.037	3.53 (0.51)	3.17 (0.39)	0.048
Mean score of Question 2 (SD)	3.41 (0.50)	3.00 (0.37)	0.01	3.38 (0.50)	3.05 (0.42)	0.07
Mean score of Question 3 (SD)	3.11 (0.33)	3.06 (0.70)	0.80	3.23 (0.43)	3.17 (0.39)	0.72

PAL: Peer-Assisted Learning, SS: Self-Study

the topic of ECG interpretation. To the best of the author's knowledge, this is the first study in Thai medical school that evaluate the effectiveness of PAL in this topic.

The fifth year medical students had higher overall pre-test score than the 4<sup>th</sup> year groups, indicating the accuracy of the test. Given that the fifth year medical students have had some clinical experience with ECG interpretation during their previous rotation. In both academic years, PAL group and SS group had comparable pre-test score.

For the fourth year medical students, PAL group displayed the significantly higher post-test score and mean difference score. However, for the fifth year medical student, the PAL group post-test score was not significantly higher than the SS group. The comparison of the mean difference score was also not statistically significant.

Results from the online questionnaires showed that students from both years believe that PAL can be used to improve overall ECG interpretation skills. Only fourth year medical students found that PAL improve confidence in overall ECG interpretation when compared to self-study. Surprisingly, students from both years did not believe benefit from PAL translate into performance in real clinical settings. Nevertheless, these results may need to be carefully interpreted because not every student enrolled in the study complete the questionnaires.

In Thai medical school, clinical years

begin in the fourth year. Clinical exposure and experiences are extremely important for physicians to accurately interpret investigation results, including ECG. For the fourth year medical students with no prior experience with any patients, it is difficult to grasp the concept of reading and interpreting ECG. Although self-study can improve ECG interpretation skill in our study for the fourth year students, it was to a lesser degree when compared with PAL. Being able to communicate and discuss with their peers, receiving information from multiple people, enable students to create and summarize the key point of ECG interpretation better than reading alone by themselves. For the fifth year groups, both PAL and SS were equally effective in improving the interpretation skill. We hypothesized that knowledge gained from lectures and clinical experience in ECG in their fourth year may be enough for the fifth year students to establish the foundation of ECG reading and study on their own. This may also be the reasons of larger score gap in the online assessment observed in the fourth year groups, as the fifth year students did not find PAL classroom to be as superior as the fourth year did. Nevertheless, PAL should be considered to be another effective learning method and can be used for students with prior knowledge as the fifth year PAL group still showed higher mean post-test score and mean difference score, though not statistically significant.

The results were comparable to similar previous trial by Davies et al., which compared near-peer teaching and electronic self-learning in second year medical students (29). In the study, the second year medical students from University Hospital Bristol were in their pre-clinical year and did not have any clinical experience with patients before. Davies et al. found that both teaching styles could be used to improve ECG interpretation skills among students, but near-peer teaching method showed higher scores in the final assessment. Another study by Raupach et al., however, reported that PAL was not superior to SS or lectures. Instead, the knowledge gain was predicted by the type of assessment rather than the teaching method (30).

Although there was no official assessment from the instructors, every instructor in the PAL group reported that most students were actively engaged in the PAL classroom, unlike the ordinary lecture by the attending physicians. The approach resulted in positive interactions among the peers as they were more open to assisting one another in the studying, for instance, sharing of each student's mnemonic and a discussion of ideas and relevant medical techniques. Such interactions could not be performed in a conventional-style lecture.

### Limitation

Our study had several limitations. First, the pre-test and post-test used for assessment were only formative, not summative. Students were well aware that the test would not have any impact on any of their grades. This caused the students to relax and understand they may not put their maximum effort, leading to unintentionally underperformed. Secondly, due to the relatively small size of the class, we had limited number of students enrolled. Finally, the post-test was evaluated only one week after the final study. Some students had outside rotation in their curriculum and were unable to take any test after that period. Thus, we were unable to assess any retentive knowledge after the study.

### Conclusion

In our single-center experience, PAL can be used to learn ECG comparable to conventional self-study in Thai medical students. Further studies are recommended to enroll more students to get clearer and more definitive results.

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**Conflicts of Interest:** None declared.

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