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Lecture based versus peer assisted learning: quasi-experimental study to compare knowledge gain of fourth year medical students in community health and nutrition course

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Abstract

Background: The present study was designed to compare the knowledge gain of students in lectures and peer assisted learning (PAL) via end of course test scores. The purpose of this comparison was to assess the ability of PAL in enhancing academic achievement and to consider its addition within the traditional medical syllabus.

Methods: A randomized control trial (RCT) was conducted at Department of Community Medicine, Lahore Medical and Dental College in 2014. Convenience sampling was used and out of 125 fourth year MBBS students, those who agreed to take part in the study (N=99), were randomly allocated to PAL (n=49) and lecture (n=50) groups. *Community Health & Nutrition* was the course chosen for the study. Both lecture and the PAL sessions were conducted simultaneously and the duration and content covered in each session were the same for both groups. Knowledge gained was assessed through a pre- and post-test. Chi-square test, independent *t* test, paired *t* test and analysis of covariance (ANCOVA) were used for data analysis.

Results: The study participants demonstrated a significant difference in the pre-test and post-test scores in both the study groups ($P \leq 0.001$). However, no statistically significant difference was found in the post-test scores between the Lecture and PAL groups, $F(1, 95) = 0.584$, $P = 0.447$. Gender and high school qualifications had no bearing on test scores in both learning groups.

Conclusion: The present study concludes that in terms of academic achievements, PAL was equally effective to lectures. Therefore, PAL can be incorporated as a supplement to lectures in medical school curricula.

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Introduction

In light of the directions provided by statutory bodies, the medical doctors of tomorrow ought to be professionals with skills for self-guided and continuous learning, teamwork, leadership and good communications and teaching skills.[1-4] Medical curricula are now being modified relevant to the competencies required of medical graduates. This entails a paradigm shift from the established teacher focused instructional approaches to more student-centered learning activities[5] and making a judicious selection of learning tools.[6] The strategic choice of teaching learning activities plays a major role both in the perceived satisfaction and also in the knowledge gained by medical students.[7,8]

Among the instructional tools identified for effective information transfer to learners, lectures and peer assisted learning (PAL) are two diverse educational approaches, each supporting different learning needs.[9] Lecture is the oldest and most ubiquitous method in medical institutions.[8,10-12] Specifically, lecture is easy to arrange,[10] can effectively convey information to a large audience,[9,13-15] have the potential to simplify complex concepts and produce the desired results in terms of academic achievements.[16] The popular critique of lectures include disengaged and

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passive audience[14,15,17] and inability to develop active learning skills in students.[13] In contrast to expert- led coaching, PAL is a dynamic learning stratagem, where students learn in collaboration with each other rather than taking the direct assistance of an instructor.[18] The benefits of teacher-less peer learning are speculated to include active learning at the learners' own intellectual level,[19,20] developing motivated, confident, relaxed and empowered learners.[9,18,20-22] Peer teaching is also a valuable resource to meet the increasing number of medical students.[21,23] The main shortcoming of PAL is the uncertainty about the quality of the educational process.[18,20,24,25] As an innovative pedagogy, PAL is invoking widespread interest for its addition into medical institutions globally.[8,20,22,25-30] Nevertheless, the objective learning benefits of this approach have yet to be fully established in different learning environments.

There is insufficient empirical evidence which can assess the knowledge gained by medical students through lectures or PAL. In studies, where peer assisted and expert assisted learning were compared in terms of test scores, a consensus on the superiority of one method ~~on~~ or the other was never reached. Some studies found PAL to be better than lectures,[8,27] others concluded that both strategies produced similar academic outcomes[31-33] while there is also evidence that PAL groups score less than those taught in a didactic fashion.[34,35] In Pakistan, the gap in knowledge about the effectiveness of PAL as a learning tool is very wide. This void results because there are very few medical schools in the Pakistan which have incorporated PAL in their teaching learning program or have researched its efficacy in enhancing knowledge gained by students .[9,22,33]

Lahore Medical & Dental College (LMDC) was founded in 1999 as a private sector institution, which follows a traditional discipline-based curriculum. Following the trend of adopting new innovative learning strategies, Department of Community Medicine at LMDC introduced PAL program in the fourth year MBBS class. The selected PAL model was the *same level or same class*, with *equal status* of learners. In this model, all participants were learners and teachers at the same time. PAL was incorporated as an adjunct to the traditional teaching methods, including lectures and tutorials.

The present study was conducted to assess the effectiveness of PAL in comparison with the lecture, via the end of course test scores. The purpose of the comparison was to generate evidence for making the decision about the adoption of PAL as a complimentary learning aid to lectures within the traditional medical syllabus.

Materials and Methods

A quasi-experimental study was carried out at the Department of Community Medicine, LMDC, Lahore in 2014, spread over a span of 21 weeks.

Study design

The study design used was single centre, parallel group, randomized control trial (RCT).

Inclusion and Exclusion criteria

The inclusion criterion for participation in the study was medical students with exposure to both lectures and PAL. The exclusion criterion was students who have never participated in PAL. At LMDC, the inclusion criterion was only fulfilled by the fourth year MBBS class in the subject of Community Medicine. A convenience sampling technique was used and the entire fourth year MBBS class of 2014 (125 students) shaped the sampling frame. The objectives and the methodology of the study were explained to the class. The students who agreed to take part in the study were considered the study sample (N = 99).

Randomization

A simple random allocation of 99 students was conducted for the lecture group (control group; n = 50) or PAL group (intervention group; n = 49). In order to minimize selection bias, the *allocation concealment (Masking)* technique was used in the allocation of participants to the two groups. The PAL students were further divided into five smaller clusters, with ten learners in four subgroups and nine learners in the fifth subgroup. The 26 students who did not consent to participate in the study were allowed to attend the lectures and these students were not included in the analysis of the study results (Figure 1).

Blinding

The participants were not blinded to their allocation but *blinding* of analyst was ensured until the whole data was analyzed.

Intervention

Community Health and Nutrition was the course chosen for the study. Both lecture and the PAL sessions were held simultaneously and the length and content covered in each session were the same for both groups. The *Community Health and Nutrition* course was divided into eight topics and the whole course was completed in eight, two hour sessions. The learners in both the groups were handed their personal *Community Health and Nutrition* workbook 30 minutes before the session ended, which was specially designed as an aid to re-examine and summarize the learning that takes place in the course. The workbook was also divided into eight sections, with each section corresponding to the course covered in one session. This exercise was an open book activity and the workbooks were gathered at the end of each session, to be distributed again at the beginning of the next session.

The lecture group followed the below mentioned teacher-led structured program. In one session, each topic was covered by two lectures, conducted in a lecture theatre.

Structure of each two hourly session followed by the Lecture group: Lecture 1, 40 minutes; Break, 15 minutes; Lecture 2, 40 minutes; Workbook exercise, 25 minutes.

In contrast, each PAL subgroup planned its own learning strategy, which was also spread over a 2-hour period, with workbook activity in the last 25 minutes. Each subgroup was allocated a separate room and monitored by a faculty

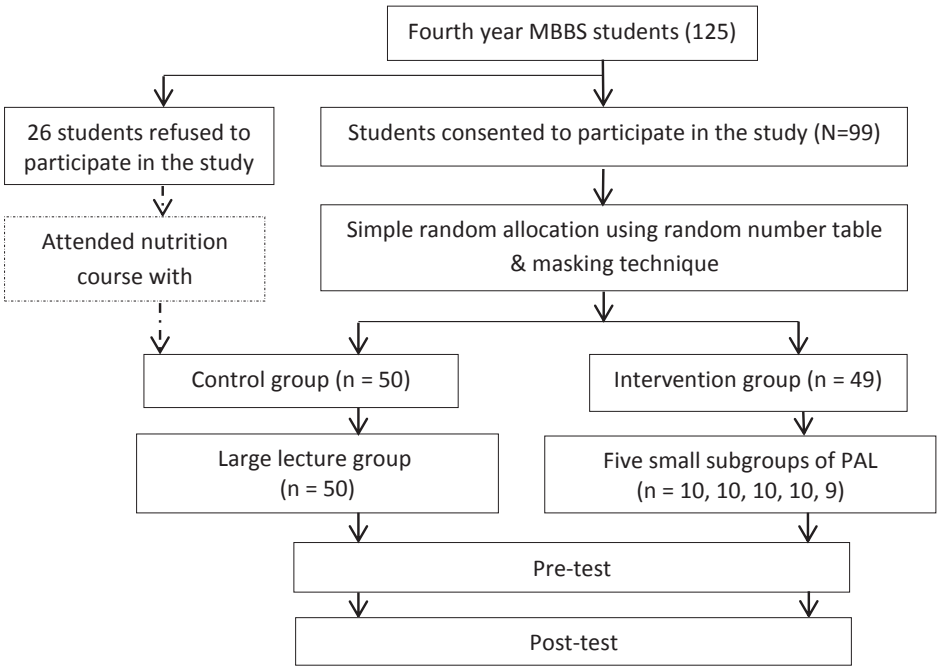

Figure 1. Study protocol flow chart.

member. The monitor did not participate in the PAL session but made sure students were working within their allocated groups. The concurrent sessions, along with the presence of a monitor and collection of workbooks before adjourning the sessions, prevented the Lecture and PAL groups from mixing and sharing information for that particular session.

Pre-test

Learners' baseline knowledge was assessed at the beginning of the course via a class test (assessment tool) of 100 marks, consisting of Multiple Choice Questions (MCQs), Short Answer Questions (SAQs) and Objectively Structured Practical Examination (OSPE). The marks allocated to the various components of the assessment were: MCQs = 20, SAQs = 40 and OSPE = 40.

Post-test

Learner knowledge gained by the end of the course was appraised by the same assessment tool that was administered as pre-test at the beginning of the course.

Data analysis

All analyses were performed according to the original assigned groups (intention-to-treat). The assessment scores of the pre-test and the post-test comprised the data. Data was analyzed using SPSS 20. Variables studied were gender and high school qualifications (independent variables) and test scores (dependent variable).

Descriptive statistics was used to present:

1. Test scores as mean and standard deviation (scores of each assessment type i.e. MCQs, SAQs, OSPE and the total test scores).
2. Demographic variables (gender and entry qualifications) as number and percentage.

Prior to data analysis, data on test scores were checked for assumptions of homogeneity of variance and normality using Levene's and Shapiro-Wilk tests. Independent *t* test was used to analyze the mean difference of pre-test scores between the Lecture and PAL groups and then again to assess the difference in the post-test scores in the two groups. Paired *t* test was used to check the difference between pre-test and post-test scores in the Lecture and PAL groups. A one-way analysis of covariance (ANCOVA) was also conducted for this study. The independent variable was educational strategies (Lecture and PAL), the dependent variable was post-test scores and the covariate was the pre-test scores. Chi-square test was applied to assess the association between gender and high school qualifications with test scores in the Lecture and PAL groups. Cronbach α was applied to assess the reliability of the assessment tool. A *P* value <0.05 was considered the cut off point for statistical significance.

Results

The response rate in the present study was 79%. Among 99 study participants, 36 (36%) were male and 63 (64%) were female. The high school qualification of 77 (78%) participants was FSc., 19 (19%) completed GCSE *A levels* and only 3(3%) had completed American Board. The lecture group had 47% males, 52% females, 47% students who completed FSc., 63% who had *A levels* as high school qualifications. In the PAL group there were 53% males, 48% females, 53% with FSc. qualifications and only 37% of those who had done *A level* (Table 1).

The reliability coefficient of the end of course test scores (assessment tool) was calculated using Cronbach α, which was 0.81.

Table 1. Demographic characteristics of study participants in lecture and PAL groups (N = 99)

	Category No. (%)	Lecture group (n = 50)		PAL group (n = 49)	
		No.	%	No.	%
Gender					
Male	36 (36)	17	47	19	53
Female	63 (64)	33	52	30	48
High school qualifications					
FSc	77 (78)	36	47	41	53
A levels	19 (19)	12	63	7	37
American Board	3 (3)	2	67	1	33

Assessment (test) scores in lecture and PAL groups

Test scores met the underlying assumption of homogeneity of variance as evidenced by $F\,(1, 97) = 2.437$, $P = 0.122$ and were normally distributed at 5% level of significance ($W = 0.987$, $P = 0.477 > 0.05 = \alpha$).

Table 2 shows no statistically significant difference between the pre-test scores of lecture and PAL groups. As depicted in Table 3, there was a highly statistically significant difference in the pre-test and post-test scores obtained by study participants in both the lecture and PAL cohorts ($P \leq 0.001$).

After applying ANCOVA, a preliminary analysis evaluating the homogeneity of regression (slopes) demonstrated no significantly different relationship between the covariate and the dependent variable as a function of independent variable, $F\,(1, 95) = 0.584$, $P = 0.447$. The ANCOVA was also not significant, $F\,(1, 96) = 0.055$, $P = 0.814$. Therefore it was concluded that there was no statistically significant difference in the post-test scores between the Lecture and PAL groups after controlling the pre-test (Table 4).

Effect of gender and high school qualifications on the test scores of the study participants

As seen in Table 5, gender and high school qualifications had no bearing on post-test scores of learners either in the Lecture or PAL groups.

Discussion

Healthcare education requires a blend of traditional and contemporary teaching and learning practices that can enhance student competencies to align with the expected requirements and anticipations. One of the major criteria for choosing learning tools is their ability to produce positive academic results. The current study compared two different approaches, PAL and Lecture, but could not establish any significant superiority of one method on the other based on post-test scores ($P = 0.81$). However, the study results demonstrated that in terms of academic achievements, the collaborative strategy was equally effective to any established traditional method in knowledge assimilation and its application. All 99 study participants performed at the same level in the cognitive (MCQs and SAQs) and practical (OSPE) aspects of the test.

The comparable post-test analogy in medical education, with no difference in educational achievements in peer-led and faculty-led tutoring, has also been described in previous studies. Bentley and Hill[31] compared test scores of students tutored through teacher based versus peer supported learning in an Anatomy course. Their study

Table 2. Mean comparison of assessment scores and t test results in lecture and PAL groups (N = 99)

Assessment	Groups	n	Mean scores	Standard deviation	Mean difference	95% CI of the difference		*t* value	*P* value
						Lower	Upper		
Pre-test									
MCQs	Lecture	50	8.08	2.257	– 0.206	–1.084	0.672	–0.465	0.643
	PAL	49	8.29	2.141					
SAQs	Lecture	50	8.38	3.591	–0.089	–1.590	1.411	–0.118	0.906
	PAL	49	8.47	3.927					
OSPE	Lecture	50	14.10	3.436	-0.124	–1.698	1.449	–0.157	0.876
	PAL	49	14.22	4.403					
Total	Lecture	50	30.76	6.483	–0.424	–3.302	2.455	–0.292	0.771
	PAL	49	31.18	7.894					
Post-test									
MCQs	Lecture	50	15.86	3.405	–0.426	–1.878	1.027	–0.582	0.562
	PAL	49	16.29	3.868					
SAQs	Lecture	50	21.68	7.075	0.353	–2.680	3.387	–0.231	0.818
	PAL	49	21.33	8.107					
OSPE	Lecture	50	31.60	5.570	1.090	–1.513	3.693	–0.831	0.408
	PAL	49	30.51	7.371					
Total	Lecture	50	69.16	13.695	0.731	–5.479	6.942	–0.234	0.816
	PAL	49	68.43	17.268					

Table 3. Paired *t* test results for comparison of pre-test and post-test scores in lecture and PAL groups (N = 99)

Groups	Assessment		Mean scores	Paired differences		95% CI of the difference		Paired *t* test	*P* value
				Mean	Standard deviation	Lower	Upper		
Lecture n = 50	MCQs	Pre-test	8.08	–7.780	4.278	–8.996	–6.564	–12.861	<0.001
		Post-test	15.86						
	SAQs	Pre-test	8.38	–13.300	7.360	–15.392	–11.208	–12.777	<0.001
		Post-test	21.68						
	OSPE	Pre-test	14.10	–17.500	6.628	–19.384	–15.616	–18.670	<0.001
		Post-test	31.60						
	Total	Pre-test	30.76	–38.400	–15.645	–42.846	–33.954	–17.355	<0.001
		Post-test	69.16						
PAL n = 49	MCQs	Pre-test	8.29	–8.000	3.953	–9.135	–6.685	–14.167	<0.001
		Post-test	16.29						
	SAQs	Pre-test	8.47	–12.857	9.231	–15.509	–10.206	–9.750	<0.001
		Post-test	21.33						
	OSPE	Pre-test	14.22	–16.286	8.332	–18.679	–13.683	–13.683	<0.001
		Post-test	30.51						
	Total	Pre-test	31.18	–37.245	18.445	–42.543	–31.947	–14.134	<0.001
		Post-test	68.43						

Table 4. ANCOVA for assessment scores and educational strategies in lecture and PAL groups (N = 99)

Groups	Sum of squares	df	Mean square	*F* value	*P* value
Pre-test	2.576	1	2.576	0.011	0.919
Lecture & PAL groups	13.576	1	13.576	0.55	0.814
Error	23500.144	96	244.793		
Total	23516.296	98			

Abbreviation: ANCOVA, analysis of covariance

Table 5. Chi-square test results for effect of gender and high school qualifications on post-test scores of students in Lecture and PAL groups (N = 99)

Groups	Assessment	Gender	Mean scores	Chi-square test	*P* value
Lecture n = 50	MCQs	Male	15.29	12.180	0.431
		Female	16.15		
	SAQs	Male	17.71	25.342	0.333
		Female	23.73		
	OSPE	Male	29.71	19.548	0.359
		Female	32.58		
	Total	Male	62.71	27.718	0.479
		Female	72.48		
PAL n = 49	MCQs	Male	16.05	2.886	0.984
		Female	16.43		
	SAQs	Male	19.21	28.781	0.151
		Female	22.67		
	OSPE	Male	29.0	23.235	0.332
		Female	31.47		
	Total	Male	64.26	37.767	0.301
		Female	71.07		
Groups	**Assessment**	**High school qualifications**	**Mean scores**	**Chi-square test**	***P* value**
Lecture n = 50	MCQs	FSc.	16.08	14.457	0.272
		A levels/American Board	15.29		
	SAQs	FSc.	22.28	24.289	0.388
		A levels/ American Board	20.14		
	OSPE	FSc.	32.56	19.742	0.348
		A levels/ American Board	29.14		
	Total	FSc.	70.94	27.679	0.482
		A levels/ American Board	64.57		
PAL n = 49	MCQs	FSc.	16.05	9.750	0.463
		A levels/ American Board	17.50		
	SAQs	FSc.	21.75	22.526	0.429
		A levels/ American Board	19.12		
	OSPE	FSc.	30.76	26.186	0.199
		A levels/ American Board	29.25		
	Total	FSc.	68.93	44.120	0.115
		A levels/ American Board	65.88		

also failed to demonstrate any statistically significant difference in student grades between two groups ($P=0.55$). Manzoor[32] checked the effectiveness of lectures and PAL in the Community Medicine course on *Prevention of Non-Communicable Diseases,* in fourth MBBS class. Her results showed no significant difference between the two study groups on the basis of academic scores obtained in MCQ tests ($P=0.47$). Ten Cate[33] conducted a long-term analysis of academic outcomes of test scores between peer instructed and the teacher taught groups in multi-disciplinary courses like *Metabolism* or *Circulation*. His results also reinforced that peer learning could not produce better results than teacher led courses, but at least it did not negatively affect academic achievement.

In contrast to our findings, some studies established that students undergoing PAL produced better academic results than those who were in faculty-led teaching programs. Abedini et al[8] tested students in a Pharmacology course using MCQs. Their results indicated post-test marks obtained by PAL cohort was significantly higher than the lecture group ($P \leq 0.02$). Similarly, Peets et al[27] assessed student learning in a Gastroenterology/Hematology course, where some of their study participants were in the PAL sessions and the rest were receiving didactic lessons. Learning outcomes were evaluated through MCQs. In this study, the PAL group's marks were notably better than the students taught through didactic method ($P \leq 0.01$).

Poor performance in PAL cohorts was also reported by studies conducted by Knobe et al[4] and Walsh et al,[35] who noticed that students taught by peers obtained significantly lower marks than those taught by expert teachers in complex skills.

In the current study, gender and educational background had no bearing on the test scores. No research was available for the comparison of this finding.

Limitations of the study included small sample size, sampling bias, restricted generalizability and limited external validity. In the present study, no method was used to balance randomization.

Conclusion

The present study concludes that Lecture and PAL are both effective strategies for academic achievement. Students who were tutored by other students performed equally well compared with their peers in an expert led program. Therefore, it can be concluded that PAL can easily be incorporated in LMDC as a supplement to lectures in the evolving medical school curricula. It is suggested that more multi-centre, multi-subject research should be conducted, with larger sample sizes to obtain more reliable evidence on the suitability of PAL as an academic tool in medical education.

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Ethical approval

Written approval for execution of the project was obtained from the LMDC Ethical Review Committee (ERC). Informed written consent of learners was obtained for participation in the study, random allocation to experimental or control group and for later publication of study results.

The assessment of the Lecture and PAL groups was only for the purpose of the study. The test scores obtained from the *Community Health and Nutrition* course were not included in the formative or summative assessments of the fourth year MBBS class.

Competing interests

The authors declare that they have no competing interests.

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