



The Effect of Peer Assisted Learning on Medical Students' Learning in a Limb Anatomy Course

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Abstract

Introduction: Peer assisted learning (PAL) is the expansion of knowledge and abilities through active assistance and guidance among groups of people who are not trained teachers, but still assist and support one another's learning. The aim of this study was evaluation of PAL in teaching skills and learning limb anatomy for medical students.

Methods: In this quasi-experimental study, students entering Yasuj University of Medical Sciences (YUMS) in academic year 2012-13 were allocated to two equal groups of 28 participants, with PAL as the intervention group and conventional teaching methods as the comparison group at the beginning of the fourth week of the course. The course content for the PAL group was divided into seven roughly equal parts, the duties of students were determined and the time table was the same for two groups. Formative exams from each topic and summative exams about upper and lower limb anatomy were given. Abilities and skills of peer teachers were assessed by a researcher-made questionnaire through peer assessment. Data was analyzed using a paired t-test.

Results: The mean scores of the PAL intervention group showed a significant statistical increase on seven out of ninth formative exams in relation to the comparison group ($P < 0.05$). The mean differences (confidence interval) of the nine formative exams were (-.25, -1.98, 1.48), (-.59, -1.66, 1.43), (-1.75, -3.46, -.04), (-1.99, -3.14, -.86), (-1.61, -1.98, -1.48), (-2.04, -3.66, -.43), (-1.75, -3.46, -.039), (-1.89, -3.14, -.93) and (-1.62, -2.84, -.41), respectively. Scores on both summative exams in the PAL group indicated statistically significant differences compared to those of the comparison group ($P < 0.05$). Mean differences and CI of multiple choice, naming pictures and short answer questions of the midterm exam were (-1.46, -2.52, -.4), (-1.52, -2.2, -.01) and (-1.1, -2.57, -.42), respectively, and for the final exam they were (-1.21, -2.59, -.4), (-1.68, -2.65, -.47) and (-1.09, -2.2, -.01), respectively. Descriptive statistics showed that the abilities and skills of peer teachers in gradually improved in the majority of areas improved.

Conclusion: The mean scores of PAL group were higher than those of the comparison group. Since learning in this method occurs through debate and discussion and acquisition of skills and communication grew in students, it could be an accountable approach.

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Introduction

Peer education has been discussed in different articles in various terms such as education through peers, peer assisted learning, peer teacher and student as a teacher. This educational intervention covers student-centered strategies and its use is growing in medical and paramedical

programs.¹

Different definitions of peer education have been used, including an educational strategy used to develop knowledge and skills through active assistance and support of people on the same level,¹ people from the same social

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groups who are not certified teachers helping each other through teaching and understanding, both to learn and to teach others² and one of the active learning methods that effectively educates students.³

In theory, education advocates believe that success lies in the fact that students as peer teachers share learning experiences. In other words, it is explained as "cognitive congruence;" students understand their classmates and explain concepts at the appropriate level. It is reasoned that peer teachers and students enjoy a "social congruence" because of their similar social roles. For this reason, researchers state that students feel more comfortable with their classmates than a teacher because of the understanding of one another's language that students share.⁴⁻⁵

The advantages which have been reported for this method, include increased self-confidence, cooperation among groups in health information transfer, learning preferences, participation, leadership and learning opportunities for students and student-teachers' satisfaction and mutual trust, improving psychomotor and cognitive learning skills, student test scores, academic performance, decreasing extra cost for educational institutions, enhancing oral presentation skills, teamwork, decision-making, responsibility, critical thinking skills, improving academic behaviour and helping students to bridge the gap between being a student and a physician in service. It is also an effective method for controlling stress at the entrance to the clinic.⁶⁻¹³

The successful implementation of PAL needs infrastructure such as the selection of appropriate trainers, acceptable preparation of educators, motivated educators, changing educational regulations, planning and monitoring.¹⁴

Nowadays, the dominant method in training of medical students, especially in basic sciences, is lecturing, so often students' education is not aligned with the expected competencies upon graduation, such as communication skills, teaching abilities, elaborated knowledge, self-learning and knowledge management.

Regarding the authors' research, the effect of PAL in Iran has not been studied in the basic medical sciences.

Considering the circumstances, we decided to evaluate the effect of PAL on learning and the abilities and skills for teaching classmates in a limb anatomy course using a quasi-experimental research method during the academic year 2012-13.

In order to implement PAL, Yasuj University of Medical Sciences (YUMS) provided some educational infrastructure.

Materials and Methods

In this quasi-experimental study, the primary goal was to examine whether study participants who were taught by their classmates through the PAL method (intervention group) learned better than study participants who were taught by their teachers (comparison group). The secondary goal of this study was to examine the teaching abilities and skills of students as teachers that taught their classmates.

Study design

This is a prospective, single-center, rater-blinded, two-arm, parallel-group randomized controlled trial.

Setting and participants

This study was carried out in the Department of Anatomy at Yasuj University of Medical Sciences (YUMS). The research sample consisted of all 56 medical students (census method) entering YUMS in academic year 2012-13. The students chose the three-unit course limb anatomy in February of the same year. None of the attending students chose this course previously. All of students except three passed the four-unit trunk anatomy course in the previous semester.

Inclusion and exclusion criteria

Inclusion criteria were students enrolled at YUMS Medical School during their Basic Sciences years. Exclusion criteria were students who had already participated in the limb anatomy courses or who had experience in PAL or any other form of student-centered learning method.

Baseline test

At the beginning of the fourth week, a test was taken after teachers presented the summary of the course to all students in six two-hour sessions over three weeks. The test consisted of multiple choice questions, short answer questions and naming the anatomical images.

Randomization

After the participants finished the baseline test on the summary of the course, an employee of the Department of Biostatistics at YUMS performed the randomized distribution of subjects using Microsoft Excel software. The employee responsible for the randomization and group assignment was otherwise not involved with the training, tests and data in the present study. Study participants were sorted regarding scores of the course summary test and then they were divided by block randomization with score variable blocks in a 1:1 ratio to either an intervention or a comparison group of 28 participants. Then students were divided by block randomization with score variable blocks into seven subgroups of four in the intervention group.

Training curriculum

The curriculum used multiple training modalities to give a variety of learning opportunities to the trainees in order to ensure high motivation. In the present study educational materials included reference books, atlases, models, cadavers, training videos and teacher slide sets for both groups. Educational content, time tables and evaluation methods were similar for both groups. All content was prepared in the form of Reusable Learning Objects (RLO) that were accessible for both groups. Content for the intervention group was divided into five roughly equal parts, each part was given to a group of 5-6 students and the tasks each student would teach were determined. The intervention group had two formal sessions over two weeks to prepare lessons at the level of mastery learning for presentation. Both theoretical and practical units were

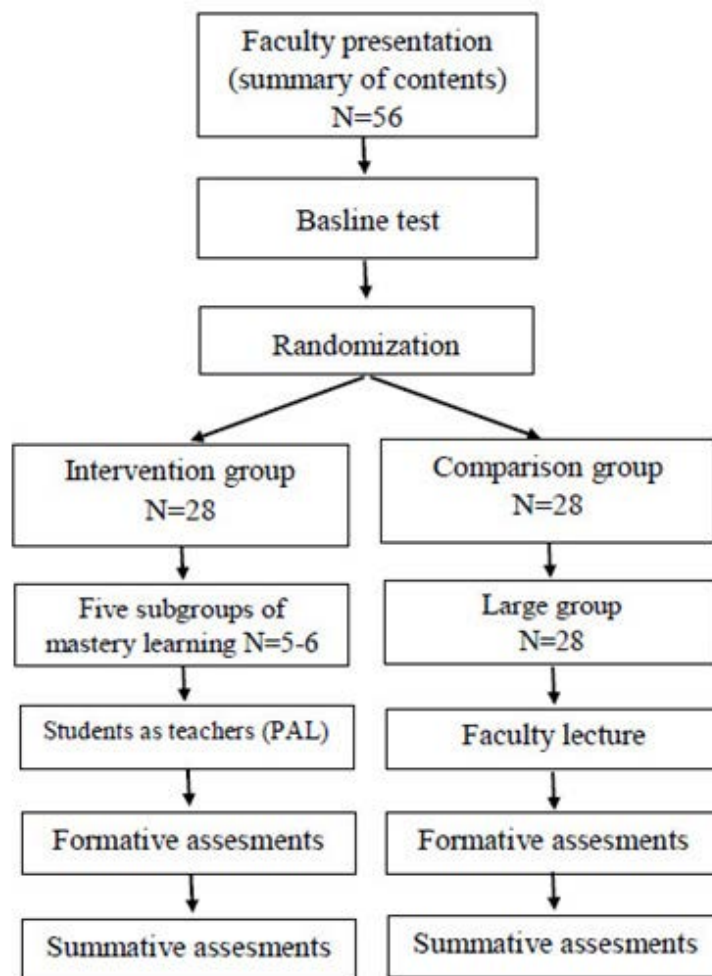


Figure 1. Study protocol flow chart

presented by peer teachers to their classmates while a dedicated tutor was present in each subgroup. All students taught 4-5 of their classmates in PAL groups for two sessions.

Teaching methods and the assessment of peer teachers by the dedicated tutor and classmates were explained to the students in order to prepare them before their presentation in the subgroups. Peer education settings consisted of a separate physical space, round table, 42-inch screen, whiteboard and their own personal laptops. The dedicated tutor monitored group dynamics and learning processes and provided appropriate feedback.

For the comparison group, lectures were given on the theoretical units and models and cadavers were used on the practical units in the same way as previous years.

Both groups were allowed to use all facilities in the model and dissection halls equally. PAL subgroups had the opportunity to study, practice, give tests and get ready to present content to their classmates during one week. According to the time table, each peer teacher should present the determined content to his/her subgroup during two sessions in a one-week period.

Post-tests

Formative exams were taken by all students at the end of

each topic in the form of MCQ. After completing upper limb and lower limb topics, summative midterm and final exams were taken, respectively. Summative exams included MCQ, naming the pictures and short answer questions. Teaching abilities and skills of peer teachers were assessed by the "peer assessment method" via a researcher-made questionnaire. The students were guided to complete it.

Measurement tools validity and reliability

We used a researcher-made questionnaire consisting of 16 questions designed with Likert-scale scoring criterion for each question as very good (5), good (4), moderate (3), weak (2) and very weak (1). The total questionnaire scores were computed by adding the scores for all items. Minimum and maximum scores in the questionnaire were 16 and 80, respectively.

The teachers were blinded to all formative and summative exams. The questions were selected from a department question pool by the YUMS assessment center with appropriate content coverage and content relevance of the course. Reliability of all exams were analyzed by KR(20) and Cronbach's alpha. The reliability of all exams was higher than 0.7.

The questionnaire for teaching abilities and skills of peer teachers had seven areas including preparedness,

Table 1. Subjects of the upper and lower limbs were divided in five parts and were assigned to five groups of participants.

Groups	Subjects from upper and lower limbs
1	1. Bones & joints of upper limb 2. Bones & joints of lower limb
2	1. Pectoral & Scapular Regions 2. Anterior & medial sides of thigh
3	1. Axilla & Connecting muscles 2. Gluteal & Region and back of thigh & Popliteal
4	1. Arm & Front of Forearm 2. Front of leg, dorsum & sole of Foot
5	1. Back of forearm, Hand and superficial vein & nerves 2. Lateral & Back of the leg

information and knowledge management, communication, responsiveness to classmates, time management, presentation and interest. The validity of the questionnaire was approved by experts' opinions. In order to calculate reliability of the questionnaire, 24 questionnaires completed by students in the first session were analyzed and Cronbach's alpha was estimated as 0.82.

To control the effects of time and maturation as potential confounding variables, the data on teaching abilities and skills of peer teachers were collected from six successive sessions, the data on formative assessment were from nine successive exams and the data for summative assessment were from two exams, a midterm and a final, taken by the two groups simultaneously.

Data analysis

Data analysis was done by version 14 of SPSS software using descriptive statistics for data on teaching abilities and skills of peer teachers and independent t-tests for data on formative and summative assessments.

Ethical Issues

Permission of the authorities was obtained to start the research. Participants signed a consent form that informed them of the nature of the project. There was no ethical barrier in this study because students completed anonymous questionnaires.

Results

Trial status

Recruitment started in February, the baseline test and randomization occurred in March, PAL started in April, the summative midterm assessment was completed in May, PAL ended in June and the whole project was planned to be finished in June 2013.

All of students attended exams and all of them completed the questionnaire. The demographic characteristics of participants are reported in table 2.

The results of this study will be presented in tables 3 and 4 and graph 1. The means of formative and summative

exams in the intervention and comparison groups and the average of peer-teachers' skills and abilities in teaching their classmates were compared in six consecutive sessions. Formative assessments results

The independent t-test showed that the mean scores of students in nine consecutive formative exams indicated no significant differences between the first and the second exams, but the third to the ninth exams in the intervention group showed a statistically significant increase compared to the comparison group ($P < 0.05$) (Table 3).

Summative assessments results

Independent t-test showed that the mean scores of students in the intervention group had a statistically significant increase in two summative (midterm and final) exams including MCQs, naming the pictures and short answer questions compared with the comparison group ($P < 0.05$) (Table 4).

Teaching abilities and skills results

Descriptive statistics showed that the teaching abilities and skills of peer teachers in the seven areas of preparedness, information and knowledge management, communication, responsiveness to classmates, time management, presentation and interest in six consecutive sessions increased gradually, except for in a few cases (Graph 1).

Discussion

Peer teaching, peer assessment and feedback, peer mentoring and peer leadership are different types of peer assisted learning that have been identified.¹⁵ Positive and constructive criticism about communication skills, professionalism, and clinical problem solving skills and clinical performance have been provided by opportunities thorough peer assessment and feedback in different medical schools.¹⁶ Peer mentoring is a mutually supportive relationship among students with different levels of academic or work experience in a professional program and focuses more on emotional support and encouragement, rather than on peer teaching and learning.¹⁵ Peer leaders supervise their colleagues and can provide clinical supervision by making correct decisions.¹⁶

Comparison of the mean scores of nine consecutive formative exams on limb anatomy for medical students indicated no significant differences between the first and the second exams, but the third to the ninth exams in the intervention group showed a statistically significant increase compared to the comparison group ($P < 0.05$) (Table 3).

An important feature of formative exams is reflection on the performance of teachers and students. The feedback that teachers give students is more effective on their practice and learning. After giving feedback, the intervention group was requested by teachers to describe how they prepared and studied, and what their opinions were about the results they obtained. Students should reach an agreement on a plan for more effective activities before future sessions.

Students were gradually experiencing listening and asking skills and were able to detect important content. Peer

Table 2. Demographic characteristics of participants in intervention and comparison groups.

Groups	Number	Mean	95% CI for age	Gender	
				Male	Female
Comparison	28	19	17.12-20.88	24	32
Intervention	28	19	17.2-20.8	42.86 %	57.14 %

Table 3. Mean comparison of nine formative exams' scores in intervention (Interv.) and comparison (Comp.) groups

Formative Exams	Groups	N	Mean	Std. Deviation	Mean Difference	95% CI of the Difference		P-Value
						Lower	Upper	
Exam 1	Comp.	28	14.28	3.44	-.25071	-1.97763	1.47621	0.46
	Interv.	28	14.06	2.99				
Exam 2	Comp.	28	14.23	2.75	-.59429	-1.66041	1.42601	0.16
	Interv.	28	14.82	2.18				
Exam 3	Comp.	28	12.18	2.79	-1.74821	-3.45680	-.03962	0.02
	Interv.	28	14.23	3.23				
Exam 4	Comp.	28	13.94	2.81	-1.99964	-3.13934	-.85995	0.05
	Interv.	28	15.18	1.27				
Exam 5	Comp.	28	12.67	3.28	-1.61162	-1.97763	-1.47621	0.04
	Interv.	28	14.42	3.09				
Exam 6	Comp.	28	12.51	2.38	-2.04321	-3.66041	-.42601	0.04
	Interv.	28	14.13	2.16				
Exam 7	Comp.	28	13.12	2.29	-1.74821	-3.45680	-.03962	0.02
	Interv.	28	15.12	1.95				
Exam 8	Comp.	28	13.40	2.06	-1.88762	-3.14234	-.92995	0.05
	Interv.	28	14.96	1.89				
Exam 9	Comp.	28	13.18	2.06	-1.62286	-2.83990	-.40581	0.05
	Interv.	28	14.67	1.89				

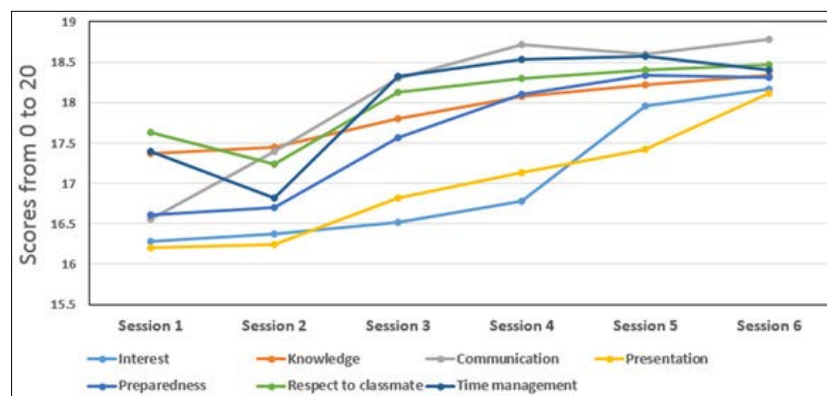
Table 4. Mean comparison of two summative (mid-term and final) exams in intervention (Interv.) and comparison (Comp.) groups

Summative Exams	Groups	N	Mean	Std. Deviation	Mean Difference	95% CI of the Difference		P-Value	
						Lower	Upper		
Mid-Term Examination	MCQ	Comp.	28	14.4	2.23	-1.45893	-2.51709	-.40077	0.05
		Interv.	28	15.86	2.46				
	Images	Comp.	28	14.36	2.57	-1.51575	-2.19912	-.01017	0.02
		Interv.	28	17.29	2.81				
	Short answer	Comp.	28	12.84	2.97	-1.10464	-2.57227	-.42359	0.04
		Interv.	28	14.64	3.32				
Final Examination	MCQ	Comp.	28	14.23	1.72	-1.21353	-2.58674	-.40059	0.04
		Interv.	28	15.34	2.18				
	Images	Comp.	28	16.45	3.9	-1.67925	-2.64727	-.46783	0.03
		Interv.	28	18.38	3.82				
	Short answer	Comp.	28	15.72	2.61	-1.08641	-2.20070	-.00858	0.05
		Interv.	28	17.29	2.83				

teachers received feedback on their presentation skills. Students' negotiations led to the establishment of enhanced mechanisms underlying empathy needed to promote and institutionalized. These are the reasons for the significant increase in the third to the ninth formative exam scores of students in the PAL group compared with those of the comparison group.

It can be said that students need a period of time to cope with a new approach, perceive the meaningfulness of learning through this approach and grow an intrinsic interest through their engagement in learning.¹⁷

Secomb published a systematic review on the PAL teaching & learning method which reported that 5 out of 12 articles from five countries stated that PAL caused improvement in cognitive domains in students.³ Dandavino et al. reported that, "medical students with a better understanding of teaching and learning principles may become better learners".¹⁸ It was also reported that the PAL method enhances inter-group cooperation in the health information transfer.¹⁵ Students within the group and between groups communicate and collaborate. So, their confidence and understanding increases and they



Graph 1. Mean comparison of abilities and skills of peer teachers in six consecutive PAL sessions (Descriptive statistics).

learn active learning methods.^{9,19}

The comparison of the mean scores of two summative exams including MCQ, naming the pictures and short answer questions indicated that there were statistically significant differences in the intervention group compared with the comparison group ($P < 0.05$) (Table 4).

Learning in the intervention group was achieved as a result of individual study and discussion and criticism of students on important issues, while in the comparison group learning was the result of individual study. The differing processes could cause a significant increase in the scores of students in the intervention group.

The positive and effective impact of PAL included increased confidence and knowledge of the students, while its negative impact was related to low-learner students whose personality and learning style did not match PAL. It was necessary to solve this problem using different methods and educational resources along with PAL. Students who believed in PAL and had analytical and reflective characteristics achieved a high level of cognitive domains.³ Students who learned in active ways, spent more time on duties with others and took part in performance of their tasks subsequently learned more and persisted longer.²⁰ Learners who communicated, cooperated and collaborated in groups increased their understanding and, thereafter, achieved higher scores.⁹

Mehrabi and his colleagues evaluated the effect of peer assisted learning on clinical reasoning in students of medicine in clerkship and internship phases, and reported that the mean difference of trainees' scores in domains of information gathering, hypothesis formation and problem solving showed a statistically significant increase in the case group in comparison with the control group.²¹

Iram from Lahour University compared students' scores in peer assisted learning with expert assisted learning and did not report significant statistical differences.²²

In the present study, the abilities and skills of peer teachers in seven areas including preparedness, information and knowledge management, communication, responsiveness to classmates, time management, presentation and interest in six consecutive sessions increased gradually, except for in a few cases (graph 1).

The abilities and skills measured in this study were diverse and complex and some of them were related to several factors. Responsiveness to classmates, communication skills and interest in performing the duties were instances of professionalism related to students' attitudes. Time management and presentation needed to be practiced and good performance of their counterparts should be emulated. In PAL, students reviewed, analyzed and criticized the events within the groups in a relatively unprejudiced manner and were open-minded about peer reviewing each other according to the checklist of peer teacher evaluation.

Supporters of the meta-cognition idea argue that a learner who has comprehensive meta-cognitive skills can intelligently control learning tasks, planning and choosing learning strategies, monitoring the learning process, correcting errors and modifying the behavior and learning strategies, when it is necessary.²³

Social constructionists theorize that learning is the process of social active interaction, structured and considered to be cumulative. Thus, new knowledge is integrated and understood through interactive social processes, involving discourse-based, adaptive, collaborative, and reflexive qualities.²⁴

Secomb reported that students who learned to teach each other had positive effects on their own psychomotor development. He also suggested that more qualitative and quantitative research findings would be needed to support this method.³

Dandavino et al. reported that, because teaching is a crucial part of physician-patient interaction, medical students might become better communicators as a result of the PAL method. Medical students will be residents, consultants and faculty members in the future with formal teaching roles. Experience with different teaching principles, skills and techniques should be done in a sequential fashion during a physician's educating, beginning in medical school and persisting throughout postgraduate education and into practice.¹⁸

In numerous studies, it has been reported that PAL improved students' academic performance¹⁰⁻¹³ and enhanced oral presentation skills, teamwork, decision-

making and responsibility.^{2,7} The development of critical thinking skills has also been reported as an advantage of this method.⁸

Professional medical educators made many efforts to formalize PAL education at both the undergraduate and postgraduate levels. In the UK, the emphasis has been on peer education and benefits associated with it. The general Medical Council (GMC) announced in a formal statement that medical graduates should "be able to provide appropriate teaching skills".²⁵

In a 2010 survey in the United States, it was reported that 99 (76%) out of 130 medical schools used peer education and PAL to teach medical students. In addition, 57 (44%) of schools reported that they encourage their students to act as teachers and instructors and provided formal training programs for medical students as teachers (mSAT).²⁶

In a society where educational systems accept educational methods without debate and criticism and reflect without thinking, the risk of the emergence of human resources without the power of thinking and intelligence in the community is high. Teaching, in such a community, means to transfer knowledge from the teacher to the pupil's mind, and consequently students become overloaded with materials that are not appropriate for their needs. Gradually, learning becomes boring and it not only plays no important role in construction, but also creates the field of scientific recession and provides distraction from scientific activities.²⁷

Limitations of this study included small sample size and possible bias from the students and faculty. Possible bias may arise from the relationship between faculty and students in filling the questionnaires or from dishonest answers to questionnaire because of imaginary conflicts of interest in the students' scores, despite the orientation session that was held. Possible bias may be from the explanation given by some faculty members to students in peer assisted learning groups instead of asking probing questions, in spite of the trainings.

Generalizability of the results of this study depends on three important elements, which are also common in higher education. These elements are infrastructure for implementation (needed supplies for PAL), facilitating the implementation (blended learning with electronic content) and continuous assessments (to ensure students readiness).

Conclusion

Although implementing the PAL method in the basic sciences phase is especially difficult due to the large number of students, it has many advantages, too. Since this method leads to learning thorough debate and discussion, and acquisition of skills and communication, it could be considered an accountable approach. Tension in the working environment such as concerns and trivial supervision of instructors and competitive performance of students were barriers in this method. One disadvantage of PAL might be that tutors might have different knowledge or capabilities than faculty members.

Suggestions

Researchers suggest further research employing a crossover trial study and research on a teaching skills improvement program on teaching abilities and skills of peer teachers with experimental and action research design with a larger sample need to be conducted to obtain more reliable findings.

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Competing interests

The authors hereby declare that they have no competing interests.

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