Effectiveness of Peer Assisted Learning on Academic Performance of First Phase Medical Students in Comprehending Difficult Topics of Neuroanatomy

Ruchira Sethi *[1], Shweta Jha [2], Alok Tripathi [3], Vimala Venkatesh [4].

*[1] Professor, Department of Anatomy, UNS Autonomous State Medical College, Jaunpur, India.

[2] Associate Professor, Department of Anatomy, Netaji Subhas Medical College and Hospital, Bihta, India

[3] Professor, Department of Surgery, Baba Kinaram Medical College, Chandauli, India.

[4] Professor, Department of Microbiology, King George's Medical University, India.

ABSTRACT

Background: Peer assisted learning (PAL), a dynamic teaching tool, fosters collaborative learning, knowledge acquisition, and skills development in medical education. Neuroanatomy is a critical and complex part of medical curriculum which students need to understand during initial period of anatomy learning. With the help of PAL, the struggle faced by first phase medical learners to complex learning patterns is addressed. The study aims to quantitatively define PAL's outcomes by comparison of academic scores and evaluate learner's perception towards PAL.

Material and Methods: The study was conducted in UNS Autonomous State Medical College, Jaunpur in a batch of 99 first phase medical learners (year 2022-23). Teaching material, teaching learning methods and assessment material were created from select topics of neuroanatomy. PAL session was conducted for each (5) topic with 10 tutees in each session. After every session post-test analysis was done for both tutees and tutors, followed by a survey questionnaire assessing the benefits of PAL.

Results: The results show a significant increase in performance metrics for learners after the PAL session, though the results were non-significant for tutors. The survey report suggests benefits from PAL in form of active engagement, improved problem-solving skills and enhanced critical thinking.

Conclusion: The study underscores PAL as a valuable and effective teaching tool in medical education that can be used at the very outset of medical learning. It works as a supportive aid to low performers who face challenge in handling the complex parts of a curriculum.

KEYWORDS: Peer Assisted Learning, Peer Tutoring, Medical Education, Neuroanatomy, First Phase Learners, Slow Learners.

Corresponding Author: Ruchira Sethi, Professor, Department of Anatomy, UNS Autonomous State Medical College, Jaunpur, India. **E-Mail:** ruchirasethi@gmail.com

INTRODUCTION

Peer assisted learning (PAL) activities include people from similar educational and social groupings who extend help to teach each other and otherwise are not professional teachers [1]. PAL has emerged as a dynamic and innovative approach within the realm of medical education. Its capacity to enhance

knowledge acquisition and academic performance has captivated the attention of facilitators across the globe in multiple areas of education [2,3]. In the field of medical education, this can produce effective results by its use as an active learning strategy which fosters collaborative learning and shared knowledge acquisition [3,4]. It also promotes confidence building, communication and leadership skills. With the introduction of competency based medical education (CBME) mandatory curriculum into the medical schools and working on the ultimate goal to produce an Indian Medical Graduate (IMG)- PAL works as an effective and innovative teaching tool for reinforcement of knowledge. It also promotes to develop the five essential qualities of an IMG viz; clinician, communicator, lifelong learner, leader and professional [5]. With the development of their communication skills, the students interact better with the patients and improvise better as a life-long learner [6,7].

Anatomy is recognized as a discipline which has longest curriculum with maximum number of competencies and teaching hours [5]. It poses a hurdle for first-phase students who are already adapting to the shift in learning patterns from school education to higher education. Learning the subject is the central goal of students compounded by intricacies of neuroanatomy, as it is the most challenging part of anatomy curriculum. The apprehension of neuroanatomy by students, can have repercussions in their later stages, manifesting as a challenge in applying it to clinical practice [8,9]. Reduction in teaching hours of Anatomy has furthered the burden of neuroanatomy. Students easily fall prey to teaching methodologies of superficial and rote learning. The knowledge acquired by students is easily forgotten even after a few months of the exams. An introduction of an active learning strategy can minimize the poor interest rates in neuroanatomy and help students towards deep learning and enhance their future clinical skills [10].

Earlier studies on PAL have focused on suggested improvement in collaborative, communicative and learning skills, though, there are mixed views with fear of mistrust for the peer tutors, non-productive role in undergraduate education [11,12]. Further, over the last decade, there has been a notable shift in the learning attitudes and preferences of medical students. Research indicates that traditional didactic teaching methods are no longer favoured. Instead, students exhibit a preference for interactive learning, self-directed learning, and the incorporation of dynamic learning approaches [4,7]. Taken together, this prompts the need to explore effective ways of teaching this challenging subject by creating a conducive learning environment. The study ensures to outline the quantitative data to define the outcomes of PAL in form of academic score for neuroanatomy. Amer MG et al [13] analysed the benefit of PAL using a 5-point Likert scale for both tutors and tutees. Objective, quantitative-teaching related outcomes are less utilized by early researchers. In the present project, apart from survey-based analysis, the academic score indicator was taken as a measure to demonstrate the efficacy of PAL.

Empowering learners with effective tools at the outset of their medical profession promises to enhance their learning experience throughout the tenure of medical education. The multifaceted aspects of PAL viz; analysing the impact on knowledge retention, critical thinking, communication and motivation to teach and learn, may pave a path for the introduction of PAL into the competency based medical education curriculum as a compulsory teaching learning method.

The aim of the present study is to assess the effectiveness of PAL as a teaching tool for academic performance enhancement in difficult Neuroanatomy topics of anatomy curriculum for first phase medical students.

METHODS

An Interventional study (independent variable- Peer assisted learning; dependent variable-academic performance) performed on Phase I medical undergraduates of UNS Autonomous State Medical College, Jaunpur, India. The study commenced after obtaining the institutional ethical clearance vide letter

no.med coll.jnp/EC/01/2023/11.

The participants were selected on the basis of following inclusion criteria: (i) willingness to participate (ii) provide written consent (iii) have desire to teach peers (iv) have required academic performance. The participants who do not provide consent and are not willing to teach were excluded from the study. All 99 eligible students of MBBS batch 2022-23 were included in the study. From this sample, 50 students were selected as peer learners and five as peer tutors (on basis of score percentile) [14].

The methodology used was as follows; From the neuro-anatomy curriculum [15], topics/competencies of high complexity and weightage (taking into consideration the impact and frequency) were defined and teaching material pertaining to these topics was created by the subject experts. Teaching learning method (TLM) and assessment material were also created (multiple choice questions, short answer question) for each competency. The batch of 99 students underwent regular academic session pertaining of that topic/competency. This was followed by a pre-validated (cronbach's á=0.78) multiple-choice questionnaire assessment [16]. The results thus obtained were compiled as pre-test scores. The assessment was planned taking into consideration the difficulty and discriminating index of the topic [17]. From the scores thus obtained, low performers and high performers were defined. Percentile for distribution of scores for each module was calculated and the students below 50th percentile were grouped as low scorers and labelled as peer learner group (PL) and above 50th percentile as high scorers and labelled as peer tutor group (PT). The PL were then scheduled for a Peer assisted learning session. Maximum number of PL that a PT can take per session was 10. After the session, again an assessment was conducted and the scores were re-compiled as post-test scores for both PLs and PTs.

The survey was done using google form links viz: **Assessing the Benefits of Peer-Assisted Learning and Assessing the Effectiveness of a peer teacher.**

The data was collected and then explored in Microsoft Excel 21. For statistical analysis, the data was transferred from Microsoft Excel 21 to SPSS 26.0.

Descriptive statistics was used for continuous variable. Mean and standard deviation of the assessment score of the study participants before the PAL session and after PAL session was assessed. Paired t test was applied for comparison of pre-test and post test score using SPSS 26.0. The p value less than 0.05 considered statistically significant. Survey analysis is documented as bar charts for closed ended /dichotomous responses after categorizing as per Likert scale from 1-5 with 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree for the specific item. A narrative summary is written for open ended questions.

RESULTS

In the examined cohort of 99 students, comprising 60 males and 39 females, a non-significant (p=0.22) difference in age between genders was observed. Furthermore, the gender distribution within each module also demonstrated non-significant (p-value >0.05) difference. Only 35% of students responded having an earlier experience of PAL. These students were further questioned and it was observed that majority of them had not undergone any PAL session in a formal setting, it was more of an informal teaching done between peers and near peers. The pre-test and post-test academic performance for each module (total 5 modules) was compared for the students who attended the PAL session and is represented in Figure 1. The box and whisker plot were constructed using the score for the assessments for each module.

There is an increase in median value, first quartile (Q1) and third quartile (Q3) values for students before and after the PAL session. The median score increased considerably for each module as shown in the figure by the centre line within the box. The mean score and standard deviation with value of significance is shown in Table 1. The scores were compared for the tutors (PT) for before and after the PAL session and the results were observed to be

non-significant at p value threshold of <0.05, as shown in table 2.

Table 1: Comparison of mean score from traditional teaching method(pre-test) and peer assisted teaching method(post-test) for tutees (PL) (p= value of significance, S=significant).

Parameter	Module 1		Module 2		Module 3		Module 4		Module 5	
Score Percentage	Pre-test	Post -test	Pre-test	Post -test	Pre-test	Post -test	Pre-test	Post -test	Pre-test	Post -test
std dev	9.89	8.24	8.76	8.6	9.6	12.43	10.2	10.77	8.44	9.52
Mean score	40.97	76.8	52.7	69.5	39.2	64.2	33.2	80.77	39.3	65.9
T value	-5.14		-2.97		-4.12		-8.32		-5.22	
p value	.000035 S		.00406 S		.003 S		< .00001 S		.000028 S	

Table 2: Comparison of scores for peer tutors before and after the PAL session SD=standard deviation, NS=non-significant

Peer Tutor (PT)	Pre-test score	Post-test score	T value	P-value
PT 1	12	13		
PT 2	13	13		
PT 3	13	14	-1	0.17 NS
PT 4	13	12		
PT 5	12	13		
Mean ± SD	12.6±0.3	13±0.5		

A. Pre-test scores for Peer Learners

■ Module 1 ■ Module 2 ■ Module 3 ■ Module 4 ■ Scores

B. Post-test scores for Peer Learners
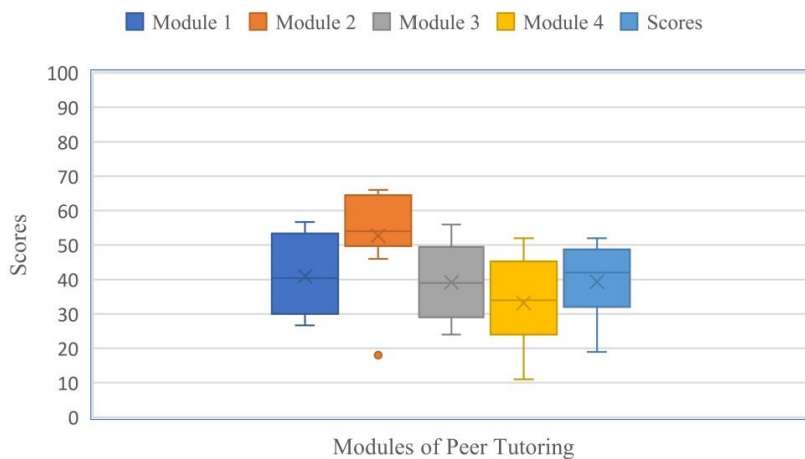
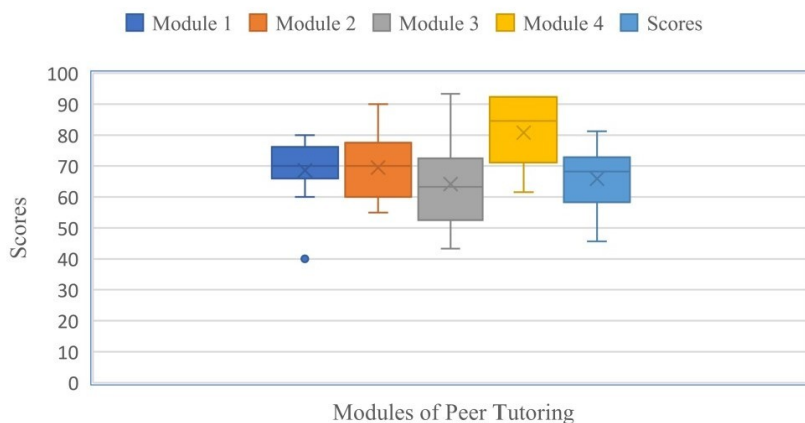■ Module 1 ■ Module 2 ■ Module 3 ■ Module 4 ■ Scores

Fig. 1: Box and whisker plot for pre-test and post-test scores for five peer assisted learning modules. Box= interquartile range (IQR), upper limit=third quartile Q3, lower limit=first quartile Q1. The line inside the box denotes the median. Whiskers represent the maximum and minimum scores. The cross represents the mean and outliers are represented as dots lying outside the whiskers.

The qualitative analysis was also taken from the survey questionnaire from google forms and the benefits acquired by the peer tutees/learners (PL) from a PAL session quantified on Likert scale. The proportion on the scale for perception towards peer assisted learning is shown in figure 2. This innovative approach reduced the complexity of topics and provided a supportive environment of learning for majority of the learners. Their active involvement in the session further enhanced their understanding and learning.
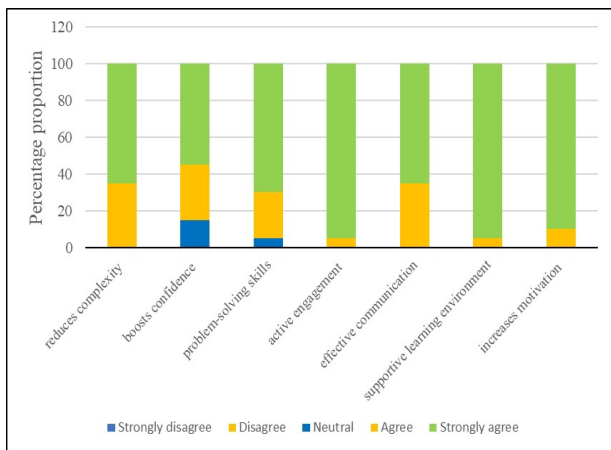

Fig. 2: Perception of learners to Peer Assisted Learning

The PAL learners also provided positive feedback for peer tutors and the results are shown in figure3. The enthusiasm of peer tutors to teach and learn suggest that this method of instruction can provide tutors with curiosity and motivation to be effective communicator and learner, as is required in CBME curriculum for an Indian Medical Graduate.The students' satisfaction was also quantified on a Likert scale and 80% students responded to strongly agree i.e receiving highest level of satisfaction towards learning. When the students were asked for how frequent would they like to have PAL sessions during their curriculum, the response recorded is shown in figure 4. The response record of open-ended questions suggest that the maximum advantage students received was communication- both for the tutors and tutees who could effectively communicate during the session and solve their queries at that very point of time. Other thing emphasized was simplification of the complex topic, the ease with which peer tutors explained that topic, made the learners less hesitant to learning.
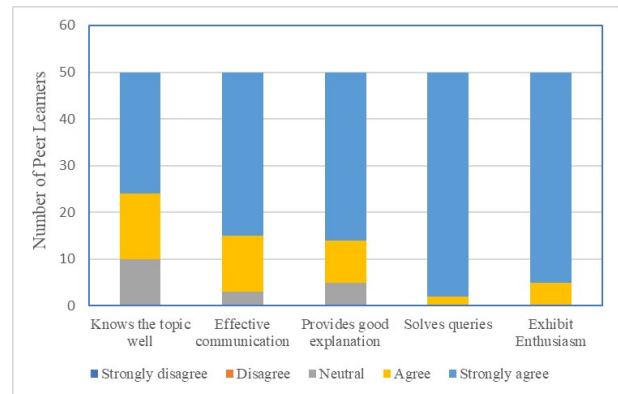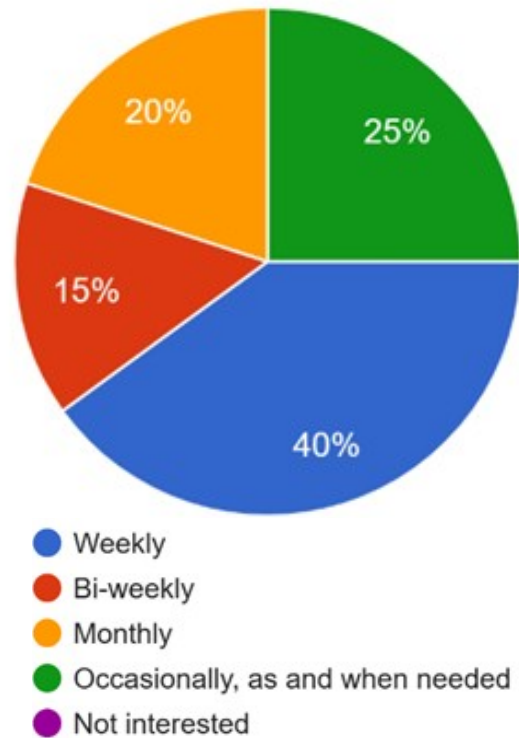

Fig. 3: Perception of peer learners for peer tutors

Fig. 4: Desired frequency of Peer Assisted learning sessions

DISCUSSION

The results from the present study affirm the effectiveness of PAL in enhancing the performance score for low achievers. PAL demonstrates a significant positive impact on learner's academic performance aligning with role of collaborative learning and knowledge acquisition. Learners consider it to be a problem solving, active method of teaching and learning. They also sync with the thought of it being able to reduce the level of complexity and enhance confidence and provide motivation towards handling of the substantial part of anatomy curriculum. Similar results were achieved by Anantharaman et al [7] in their cross-over study for osteology learning. A systemic analysis of 18

studies by Sotgiu MA et al [9] for defining most understandable method of neuroanatomy, 16.6% studies utilized peer learning as a method of instruction with positive results. Thus, use of PAL for neuroanatomy teaching provides appropriate understanding, provokes critical thinking skills and provides an elevated performance score. Benè KL et al in their study on peer tutoring emphasized on the growing number of students and static faculty size in a medical school suggesting PAL as a possible solution to this globally existent challenge [18]. Similarly, a peer assisted training module of electrocardiography utilized in physiology department suggests that low teacher-student ratio can be strategically handled by way of introduction of PAL [19].

While the results for tutors were non-significant for academic scores, their active engagement and enhanced communication skills suggest potential long-term benefits of PAL [20,21].

A study by Al Shareef SM et al [11] on reciprocal teaching as learners and tutors offers a result of benefit to tutors in communication and confidence and with enhanced presentation skills, on the other hand the benefits acquired by learners are "any time approach" to tutors. The study was targeted to students in clinical condition as compared to the present where novice medical graduate is targeted to elevate his /her understanding of basic sciences.

The integration of Likert-based surveys provides valuable insights into learners' perceptions of PAL. Positive responses indicate active engagement, improved problem-solving skills, and heightened critical thinking abilities. Learners appreciate PAL's innovative approach, emphasizing the benefits of peer-assisted learning in fostering a supportive and interactive educational environment. Similar results have been reported by earlier researchers, the studies highlighting the significance of collaborative learning [11-13].

The results from survey underscores' tutor's effectiveness in communication and understanding of the subject matter to the extent of solving queries raised by the PL. A meta-analysis by Zhang, Y et al in 2021 [22] addressed 13 studies where except for one study by Rogers in 2000 [23] rest all were performed on senior medical students and not first phase learners. A systemic review by Burgess et al [24] shows findings similar to the present study and emphasize more positive results on the tutors than tutees in form of better communication, understanding and problem-solving abilities.

All the research can-not be without contradictory comments; Omar F et al [25] editorial cites the challenges peer tutoring can bring-one being suboptimal knowledge transfer. The experience and knowledge of a senior consultant can-not be compared to a peer or a near peer tutor. But we think, this hurdle can be overcome if a judicious well -planned strategy is applied in incorporating the peer tutoring curriculum for certain pre-defined modules from a knowledge -heavy curriculum. In many of the Indian institutions post-graduate teaching is usually undertaken in form of peer learning, thus exposing the post-graduate learners to this form of teaching. The effectivity of peer learning in post-graduate education is emphasized by Elhsaan M 2017 [26].

Incorporating peer -learning in a formal systemized way at the very outset of students medical learning journey can bring about significant positive benefits.

The study has its own limitations; one being of a small sample of student, other being a single centre study. Also not having a control group for PAL learners could have been a limitation for result interpretation.

These results suggest that PAL holds promise for meeting the challenges and intricacies of medical learning by including PAL as an instructional method with active engagement, problem-solving skills, and critical thinking. The non-significant outcomes for tutors may indicate the need for further exploration into the nuances of the tutoring role within PAL. The study lays the foundation for potential integration of PAL into competency-based medical education, emphasizing its potential to augment traditional teaching methods and contribute to a more dynamic and learner-centric educational landscape.

ORCiD

Ruchira Sethi- 000-0003-2958-2510
Shweta Jha- 000-0001-6167-5683
Alok Tripathi- 0000-0002-7864-9817
Vimala Venkatesh- 0000-0003-0322-4248

Author Contributions

Ruchira Sethi: study conceptualization, first draft preparation, manuscript preparation, manuscript revision. **Shweta Jha:** manuscript preparation, manuscript revision. **Alok Tripathi:** manuscript preparation, manuscript revision, preparation of diagrams. **Vimala Venkatesh:** study conceptualization, manuscript preparation, manuscript revision. All authors read and approved the final version of the paper.

Conflicts of Interests: All authors declare that no financial support was received from any organization for the submitted work.

Financial relationships: All authors declare that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other relationships: All authors declare that there are no other relationships or activities that could appear to have influenced the submitted work.

REFERENCES

[1]. Topping, K.J. The effectiveness of peer tutoring in further and higher education: A typology and review of the literature. High Educ 1996;32:321-345
https://doi.org/10.1007/BF00138870

[2]. Andrew Jay E, Starkman SJ, Pawlina W, Lachman N. Developing medical students as teachers: An anatomy-based student-as-teacher program with emphasis on core teaching competencies. Anatomical Sciences Education. 2013;6(6):385-92.
https://doi.org/10.1002/ase.1364
PMid:23907836

[3]. Naeger DM, Conrad M, Nguyen J, Kohi MP, Webb EM. Students Teaching Students. Academic Radiology. 2013;20(9):1177-82.
https://doi.org/10.1016/j.acra.2013.04.004
PMid:23810649

[4]. Burgess A, McGregor D, Mellis C. Medical students as peer tutors: a systematic review. BMC Medical Education. 2014; 14:115-122.
https://doi.org/10.1186/1472-6920-14-115
PMid:24912500 PMCid:PMC4237985

[5]. Ananthakrishnan, Nilakantan. Competency based undergraduate curriculum for the Indian Medical Graduate, the new MCI curricular document: Positives and areas of concern. SBV Journal of Basic, Clinical and Applied Health Science. 2018; 1:34-42.
https://doi.org/10.5005/jp-journals-10082-01149

[6]. Agius A, Stabile I. Undergraduate peer assisted learning tutors' performance in summative anatomy examinations: a pilot study. International Journal of Medical Education. 2018 ;30(9):93-8.
https://doi.org/10.5116/ijme.5aa3.e2a6
PMid:29621744 PMCid:PMC5951778

[7]. Anantharaman LT, Ravindranath Y, Dayal S, Shankar N. Peer-assisted learning versus didactic teaching in osteology for first-year Indian undergraduate medical students: a quasi-experimental study. Surgical and Radiologic Anatomy. 2019;41(10):1163-71.
https://doi.org/10.1007/s00276-019-02259-y
PMid:31123772

[8]. Javaid MA, Chakraborty S, Cryan JF, Schellekens H, Toulouse A. Understanding neurophobia: Reasons behind impaired understanding and learning of neuroanatomy in cross-disciplinary healthcare students. Anatomical Sciences Education. 2017;11(1):81-93. PMid:28628732
https://doi.org/10.1002/ase.1711

[9]. Sotgiu MA, Mazzarello V, Bandiera P, Madeddu R, Montella A, Moxham B. Neuroanatomy, the Achille's Heel of Medical Students. A Systematic Analysis of Educational Strategies for the Teaching of Neuroanatomy. Anatomical Sciences Education. 2019 Feb 19;13(1):107-16.
https://doi.org/10.1002/ase.1866
PMid:30702219

[10]. Hazelton L. Changing Concepts of Neuroanatomy Teaching in Medical Education. Teaching and Learning in Medicine. 2011;23(4):359-64.
https://doi.org/10.1080/10401334.2011.611777
PMid:22004321

[11]. AlShareef SM, Aldayel AY, Alghamdi HM, Alosaimi MB, Alharbi MM, Aldayel AA, et al. Perceptions on Reciprocal Peer Teaching Among Medical Students As Learners And As Tutors. Advances in Medical Education and Practice. 2019; 10:817-27.
https://doi.org/10.2147/AMEP.S220728
PMid:31572043 PMCid:PMC6756853

[12]. Holliday, Tacy. Evaluating the Effectiveness of Tutoring: An Easier Way. The Learning Assistance Review 17;2012:21-32.

[13]. Amer, Mona & Althaqafi, Raad & Assiri, Sara & Alsufyani, Atheer & Alrubaei, Faisal & Mohamed, Nader. Peer-assisted learning: undergraduate medical students' perception and satisfaction. Millenium - Journal of Education Technologies and Health. 2021;11-22.

[14]. Ullah, Irfan & Kaleem, Muhammad. Effectiveness of Peer Tutoring on The Academic Achievements of Tutors and Tutees with Respect to Knowledge, Comprehension and Application Levels of Cognitive Domain. FWU Journal of Social Sciences. 2020;14:68-79.
https://doi.org/10.51709/FW12726

[15]. Medical Council of India, Competency based Undergraduate curriculum for the Indian Medical Graduate, 2018; 1: 72-74.
https://www.nmc.org.in/wp-content/uploads/2020/01/UG-Curriculum-Vol-I.pdf

[16]. Bujang, Mohamad Adam & Hon, Yoon Khee & Lee, Khee & Yee, Keng. A Step-by-step Guide to Questionnaire Validation Research 2022. Version v1 Institute for Clinical Research, NIH MY ISBN: ISBN: 9781005256180

[17]. Kumar D, Jaipurkar R, Shekhar A, Sikri G, Srinivas V. Item analysis of multiple choice questions: A quality assurance test for an assessment tool. Med J Armed Forces India. 2021 Feb;77:S85-S89.
https://doi.org/10.1016/j.mjafi.2020.11.007
PMid:33612937 PMCid:PMC7873707

[18]. Benè KL, Bergus G. When learners become teachers: a review of peer teaching in medical student education. Fam Med. 2014;46(10):783-7.

[19]. Kamble PH, Khare AS, Maske SS, Sharma G, Kowale AN. Peer-assisted teaching method to foster learning physiological basis of electrocardiography among 1st year medical graduate students: An interventional study. J Educ Health Promot. 2019;14(8):64.
https://doi.org/10.4103/jehp.jehp_313_18
PMid:31008131 PMCid:PMC6442245

[20]. Tai J, Molloy E, Haines T, Canny B. Same-level peer-assisted learning in medical clinical placements: a narrative systematic review. Med Educ. 2016;50(4):469-84.
https://doi.org/10.1111/medu.12898
PMid:26995485

[21]. Nevan Bermingham, Frances Boylan & Barry Ryan. The 4C's of PAL - An evidence-based model for implementing peer assisted learning for mature students, Innovations in Education and Teaching International, 2023;60(3):401-411.
https://doi.org/10.1080/14703297.2022.2050779

[22]. Zhang, Y., Maconochie, M. A meta-analysis of peer-assisted learning on examination performance in clinical knowledge and skills education. BMC Med Educ 2022; 22;147.
https://doi.org/10.1186/s12909-022-03183-3
PMid:35248051 PMCid:PMC8897892

[23]. Rogers DA, Regehr G, Gelula M, Yeh KA, Howdieshell TR, Webb W. Peer teaching and computer-assisted learning: An effective combination for surgical skill training? J Surg Res. 2000; 92:53-55.
https://doi.org/10.1006/jsre.2000.5844
PMid:10864482

[24]. Omar F, Zaheer M, Ahmed M. Effectiveness of peer teaching in medical education: medical student's perspective. Adv Med Educ Pract. 2018;9:199-201.
https://doi.org/10.2147/AMEP.S161507
PMid:29608206 PMCid:PMC5868736

[25]. Elhassan, M. The Hospitalist Huddle: a 1-year experience of teaching Hospital Medicine utilizing the concept of peer teaching in medical education. Advances in Medical Education and Practice, 2017;8:785-789.
https://doi.org/10.2147/AMEP.S149450
PMid:29263711 PMCid:PMC5724516