PEER-ASSISTED LEARNING APPROACH IN DENTAL CURRICULUM: THE IMPACT ON STUDENTS' ACADEMIC PERFORMANCES

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Abstract
Peer-assisted learning (PAL) is a peer tutoring strategy that can benefit dental education, such as enhanced experience and comprehension. The objective of the study is to assess the impact of PAL on student learning and the development of clinical skills and to evaluate the students' perceptions of this learning approach. A quasi-experimental study and online cross-sectional study were conducted from March 2022 to March 2023 to assess three main focuses, which are students' clinical competencies, students' perception towards PAL, and academic performances. This quasi-experimental study involved 82 fourth-year dental students divided into two groups to observe either orthodontic impression-taking (group A) or facebow transfer (group B) procedures for six months, followed by assessments of their clinical competencies of both procedures. Pre-seminar and post-seminar tests were done to evaluate the academic performance of fourth-year dental students. A validated questionnaire was used to assess the perceptions of 190 students from year 3 to year 5. There was no significant difference in clinical performance between groups following PAL sessions. There were weak correlations between groups A ($p=0.538$) and B ($p=0.279$), indicating a weak relationship between PAL and students' clinical competencies. However, PAL helps to improve theoretical knowledge, which showed an increase in average scores in the pre-test and post-test. Moreover, the questionnaire responses reported positive perceptions of the PAL approach. The study found no significant correlation between PAL and students' clinical performances. However, student feedback showed this approach to be beneficial in enhancing the clinical exposure of dental students and should be implemented in dental schools.

Keywords: Peer-assisted Learning, Dental Education, Clinical Competencies

Introduction

Over the past two decades, dental schools have evolved their curricula intending to foster graduates who are both reflective and competent in patient assessment skills (1). The conventional dental curriculum has been characterised by a one-way flow of knowledge from professionals to learners, typically facilitated through lectures, demonstrations, and explanations. A more recent instructional strategy, peer-assisted learning (PAL), facilitates experiential knowledge exchange among peers, especially during hands-on sessions (2). Brueckner and MacPherson (3) have identified PAL as a collaborative learning method prevalent in diverse educational contexts, including lectures, basic science labs, and clinical training. PAL promotes knowledge acquisition and skill development as peers actively support one another to achieve mutual learning outcomes (4–6). In essence, PAL engages students from similar academic standings, who are not necessarily expert tutors, to help each other in a learning journey marked by mutual mentoring (5, 7, 8). This can be distilled down to a system where students collaborate and learn as equals without any implied hierarchy (8).

The global medical education community has widely adopted PAL due to its manifold advantages. It has been demonstrated that PAL enhances students' sense of responsibility (3) and bolsters self-confidence (3, 9). Moreover, students benefit by refining their motor skills and attitudes (9), equipping them for future professional challenges (7). Furthermore, PAL fosters an environment where tutors and learners collaboratively benchmark performance, exchange feedback, and align with professional standards (6).

Active learning necessitates student involvement in deep learning activities, such as evaluation, analysis, or content creation. Such activities could span classroom dialogues, digital simulations, or role-playing sessions. In the context of the Faculty of Dentistry at Universiti Teknologi MARA (UiTM), an iteration of PAL termed Learning Through Peers (LTP) has been incorporated into the curriculum. Here, junior dental students collaborate with their senior counterparts and postgraduate trainees.

These collaborations encompass activities like observations, hands-on assistance, and in-depth discussions, all supplemented by reflections from the junior participants. Empirical studies have consistently emphasised that peer-based learning approaches surpass passive learning methods in engagement and retention efficacy. Notably, one study found that active learning strategies enhanced course-passing probabilities by 1.5 times compared to passive learning (10).

The objectives of this study are the following:

i. To assess the impact of PAL on student learning and the development of clinical skills.
ii. To evaluate the students' perceptions of this learning approach.

Materials and Methods

The study comprised of dental students spanning third to fifth years from the Faculty of Dentistry, UiTM, observed from March 2022 to March 2023. Fourth-year students were exclusively involved in this quasi-experimental study. Concurrently, a cross-sectional study gauged students' academic performance. At the study's conclusion, a questionnaire, validated beforehand, assessed students' views on PAL. Evaluative metrics covered three components: clinical competencies, theoretical knowledge, and perception towards this learning approach.

The fourth-year students comprised of 82 students. They were assigned to seven clinical groups, which included 10-12 students per group at the beginning of their clinical years. Because of this limitation, the students cannot be randomised individually to the study groups. Instead, only the clinical groups are randomised to the two clinical procedure groups. Due to the odd number of clinical groups, assigning will be imbalanced as one study group will include four student clinical groups and the other only three.

Each clinical group was assigned one PAL session per week in their clinical timetable, which equates to three hours per week. Each student had about 15 PAL sessions during their six-month observation period, equating to about 45 hours of PAL exposure.

Ethical consideration

Ethical approval to conduct this study was obtained from the Faculty of Dentistry Research Ethics Committee, UiTM (Reference: FRC/03/2022 [ERP/12/16]).

Sample size calculation

Given the known population sizes, Krejcie and Morgan's table was used to determine the sample size for both the quasi-experimental and cross-sectional investigations (11). To attain a 95% confidence interval, the quasi-experimental part of the study needed 66 participants for clinical competency assessments, while 144 participants were required for gauging PAL perceptions. Purposive sampling was employed for participant selection.

Measurement tools

i) Clinical Procedure Evaluation

Fourth-year dental students' clinical adeptness was ascertained using two predefined procedures: impression-taking and facebow transfer. Using Microsoft Excel version 16.7 (Microsoft Corporation), the fourth-year's existing seven clinical groups were randomly assigned into two groups: Group A (impression-taking) comprised of four student clinical groups, while Group B (facebow transfer) consisted of three groups. Over a six-month interval, Group A was directed to the Orthodontics PAL sessions for observation, whereas Group B was designated to the

Prosthodontics PAL sessions. The two clinical procedures were evaluated for both groups at the end of the observation period. For the impression-taking procedure, evaluations revolved around the number of attempts necessary for satisfactory impressions. Alginate impressions were taken on orthodontic patients whom the supervising orthodontist screened to be suitable to be treated with fixed appliances in the institution that fall under Index Orthodontic Treatment Need (IOTN) of grades 4 and 5.

In the facebow transfer, the time interval between anterior reference point marking and instrument detachment from patients was recorded. Only fully edentulous patients undergoing upper and lower complete denture fabrication are included to standardise the prosthodontic cases. Google Form was utilised to create the evaluation form, which the students used to record the number of attempts made during the impression-taking procedures and the time required to complete the facebow transfer steps. Online briefing sessions were conducted with the fourth-year students before the observation period and once again before the commencement of the clinical evaluation phase.

In this quasi-experiment, the groups reciprocally acted as controls: Group A served as the control for Group B's facebow transfer procedure, while Group B served as the control for Group A's impression-taking procedure.

ii) Theoretical knowledge

Paediatric dentistry postgraduate students were tasked to conduct a seminar on pulp therapy in primary teeth for fourth-year dental students. To discern the influence of peer teaching on academic outcomes, a pre-test was administered before the seminar and a post-test after concluding the seminar. The correct answers were undisclosed after the pre-seminar test was conducted. The mean scores from pre and post-tests were calculated. The test comprised of ten questions in a single best-answer format. Content experts vetted the evaluation test questions.

iii) Questionnaire

This study used a validated questionnaire based on a study by Cameron et al. (4) that included closed-ended questions (graded on a five-point Likert scale) and open-ended questions. Content experts validated the contents of the questionnaire. The questionnaire encompassed three segments: student demographics, closed-ended, and open-ended questions regarding the perspectives on PAL. The open-ended questions explored opinions on PAL, its effectiveness, and improvement recommendations. The questionnaire was distributed digitally via Google Forms.

Statistical analysis

Data were analysed using the Statistical Package for Social Sciences (SPSS) version 27. Independent t-test was used to assess the two groups' clinical competencies of the two clinical procedures. Descriptive analysis was used to compare the scores of the pre-seminar and post-seminar tests. The Chi-square test and thematic analysis were applied to the questionnaire responses to evaluate undergraduate students' perceptions towards PAL.

Results

Impression-taking procedure

For the impression-taking procedure, 80 out of 82 students' responses were obtained, 56% from Group A and 41.5% from Group B (Table 1). The mean number of impression retries was 3.43 (± 1.09) for Group A and 3.29 (± 0.94) for Group B. Independent t-test analysis showed no significant difference between the two groups (p=0.538) (Table 2).

Table 1: Number of respondents for impression-taking procedure according to groups (N = 82)

Group	Frequency	Percentage
Group A (Ortho)	46	56.0 %
Group B (Prostho)	34	41.5 %
Non-respondents	2	2.5 %

Table 2: Number of retakes of impression-taking procedure according to groups

Group	Mean	SD	P-Value
Group A (Ortho)	3.43	1.09	0.55
Group B (Prostho)	3.29	0.94	

Facebow transfer procedure

For the facebow transfer procedure, only 59 out of 82 students responded. Responses included 39% from Group A and 33% from Group B (Table 3). Group A averaged 34.78 (± 26.55) minutes, while Group B averaged 26.33 (± 31.85) minutes to complete the

facebow transfer procedure. The independent t-test showed a p-value of 0.271, signifying no significant difference between the groups (Table 4).

Table 3: Number of respondents for facebow transfer procedure according to groups (N = 82)

Group	Frequency	Percentage
Group A (Ortho)	32	39 %
Group B (Prostho)	27	33 %
Non-respondents	23	28 %

Table 4: Duration (minutes) of facebow transfer procedure

Group	Mean (Minutes)	SD	P-Value
Group A (Ortho)	34.78	26.55	0.27
Group B (Prostho)	26.33	31.85	

Theoretical knowledge

Utilising descriptive analysis, the pre-seminar and post-seminar test mean scores were obtained and compared. The average pre-seminar test score was 6.59 marks, and the post-seminar test score was 7.17, which showed increased test scores (Table 5).

Table 5: Pre-seminar and post-seminar test scores (Academic performance)

Assessment	Average	Median	Range (points)
Pre-test	6.59/10	7/10	1-9
Post-test	7.17/10	7/10	3-10

Questionnaire on Perception of PAL

The response rate was 79.3%, with 188 out of 237 dental students from years 3, 4 and 5 responding to the questionnaire. The responses were highest among fourth-year students (38.3%), followed by third-year students (32.4%) and fifth-year students (29.0%) (Table 6).

Table 6: Number of respondents for the questionnaire on PAL perceptions (N = 237, Response Rate = 79.3 %)

		Number of Respondents (N)	Percentage
Gender	Male	46	24.5 %
	Female	142	75.5 %
Year	Year 3	61	32.4 %
	Year 4	72	38.3 %
	Year 5	55	29.3 %

Table 7 shows data from closed-ended questions. The statistical analysis showed mostly positive feedback from the tutees. 42.6% of the respondents agreed that PAL was interesting. 43.1% strongly agreed that their senior peers appeared knowledgeable, and 70.2% (strongly agreed and agreed) were clear when explaining during PAL sessions. In addition, 41.0% of respondents concurred that the tutors provided helpful feedback to them. PAL sessions helped them boost their confidence in performing procedures they had observed (39.4%). Just over a third of respondents disagreed that this learning approach should not be recommended to others (36.7%).

i) Thematic analysis

Thematic analysis was used to analyse and extract the general theme surrounding the open-ended questions. The extracted positive themes from respondents were that this learning approach helped them gain exposure and experiences, acquire clinical knowledge, and improve communication gaps. On the other hand, negative feedback was generally about the time spent on PAL instead of clinical sessions and being treated only as assistants.

ii) Gained exposure and experience

"Good exposure to know how to handle some procedure that we might not have a chance to do and what materials most commonly used in the clinic, especially when to a chance [sic] to have LTP at the specialist clinic or PG clinic."

"Learning through observation is good for clinical exposure. Especially before clinical years, we had been involved in clinical settings and know the materials and procedure involved."

"It does help in terms of exposing speciality in dentistry and can make us know what speciality we want to further if we have the chance."

"It's good as getting real-life exposure can be really helpful in giving ideas, and we can see the end result after the procedure."

iii) Acquire knowledge of clinical setting

"It helps undergraduate students to see procedures that are not meant for them to do in clinics, but just in case they encounter the issue in the clinic, they can use the knowledge that they get from the postgrad [sic] student.

Table 7: Students' responses from the questionnaire on perception of PAL (N = 188)

Students' perception	Strongly agree (Score: 5)	Agree (Score: 4)	Neutral (Score: 3)	Disagree (Score: 2)	Strongly disagree (Score: 1)
I found the clinical based (LTP) sessions interesting.	32.4% (61)	42.6% (80)	20.2% (38)	3.2% (6)	1.6% (3)
The tutor (senior peers) seemed knowledgeable.	43.1% (81)	41.5% (78)	13.8% (26)	1.1% (2)	0.5% (1)
The tutor (senior peers) was clear when explaining during the sessions.	32.4% (61)	37.8% (71)	24.5% (46)	3.7% (7)	1.6% (3)
The tutor (senior peers) provided useful feedback.	27.7% (52)	41.0% (77)	23.9% (45)	4.8% (9)	2.7% (5)
I was confident in undertaking the procedure(s) following my tutor's (senior peers') explanation.	23.4% (44)	39.9% (75)	31.4% (59)	3.2% (6)	2.1% (4)
I did not feel comfortable asking questions to my senior peers.	6.9% (13)	18.1% (34)	35.6% (67)	25.5% (48)	13.8% (26)
I would not recommend this approach (LTP) to others.	4.3% (8)	5.9% (11)	28.7% (54)	24.5% (46)	36.7% (69)
This LTP approach is taking too much of my clinical time.	7.4% (14)	21.8% (41)	35.1% (66)	19.7% (37)	15.4% (29)
This LTP approach gives me confidence in conducting the procedure(s) I have observed; hence I can complete the task in a shorter time.	17.6% (33)	39.4% (74)	35.1% (66)	6.4% (12)	1.1% (2)

"It is a good opportunity for students who don't always see interesting and multidisciplinary cases in their own clinic so that they can learn and apply the knowledge in their practice."

"Was able to learn something for every session, even if it's only a small matter. Able to familiarise myself with clinical setting too."

"LTP teaches us to be more knowledgeable, especially when doing difficult procedures. Once we have learned, we can apply it to our practice."

iv) Improved communication gaps

"Comfortable to ask them personally."

"Can get new knowledge and have a chance to ask the questions if having doubt or curious on some procedure."

"Stress-free and safe, as it's being done by the senior, they are knowledgeable, and I'm willing to learn. Not all students can learn under a pressured environment, and this LTP session can teach in a more relaxed manner." "Did not have too much hesitation to ask a senior as compared to a lecturer."

v) Negative feedbacks

"It's good when we can learn something at the end of the session, but it is just a waste of time if we just are a runner to help get materials from the counter."

"I can easily understand dental skills better, but sometimes the doctor that I assisted was very annoyed with me."

"Somehow, I think it is taking our clinical time, which is supposed to be utilised to finish our clinical requirements."

"So far, I haven't learnt anything much from LTP. Most of the time, I was asked to hold the suction and get materials for the operator."

"Need to ask a lot, which might be bothersome as not all are very approachable."

vi) Suggestions for improvisation

Suggestions for improving the implementation of PAL in the dental curriculum include explaining the procedures to the students before the session, ensuring a fair division of students to each specialist/department so they get equal exposure (12), focusing on teaching and guiding students rather than just assisting, provide reflective note or diary regarding what they have learned, and tutors should be more approachable.

Discussions

The implementation of PAL in dental curricula is gaining traction in select Malaysian universities. This educational approach is beneficial for honing academic and clinical proficiencies among dental students. PAL draws on various renowned educational theories, including Socrates' idea that teaching is the finest form of learning and Vygotsky's theory of the "zone of proximal development" (12). Social interactions in this active learning session can aid students in monitoring and regulating their cognition more effectively than self-explanations (13). This research examined the influence of peer-mediated learning on clinical skill development and academic achievement and evaluated the students' perceptions when participating in PAL.

The participants selected as tutees in this study were dental undergraduate students from year 3 to year 5, with postgraduate students chosen as tutors. The rationale behind this selection stemmed from the comfort and familiarity undergraduate students felt with their peer tutors due to shared social dynamics, both being students in dental school (4). According to the Cambridge Academic Content Dictionary, a 'peer' is defined as a person of similar age, the same social position, or having the same abilities as other people in a group (14).

The impression-taking procedure was selected because it is one of the staple skills that dental students should master. This skill is utilised in most dental specialities, especially in orthodontics. Proper mixing of alginate and impression-taking techniques is crucial in attaining detailed dental impressions to be used as study models to plan for further management of patients. Facebow transfer is another fundamental technique that must be perfected before graduating from dental school. The provision of prosthetic replacements for missing teeth, such as dentures, is one of the most common services dental officers provide in primary care settings.

For the facebow transfer procedure, only 59 out of 82 students responded. This fell slightly below the required minimum sample size. This lower participation may be attributable to the survey's timing in their academic calendar. Since the assessment was conducted in the first semester of their fourth-year session, most students have yet to reach this stage of the clinical project. The use of randomisation minimised any biases (4). There could be reporting bias as the assistant of the student operator conducting the facebow transfer was required to time and record the time taken to complete the procedure.

The result of the impression-taking procedure showed no discernible difference between students who attended their peers' orthodontic sessions and those who did not. Given the ubiquity of impression-taking in dentistry, it is possible that the other group may have been exposed to this procedure during and outside their PAL sessions. To prohibit the students from observing other procedures during the designated PAL sessions would be unethical. This aligns with findings from Cameron et al., who reported similar non-significant outcomes, potentially due to the limited sample size (4). The possibility of reporting bias also exists as the students themselves are required to record and submit via Google Form the number of retakes to complete the impression-taking procedure.

The outcome of the facebow transfer procedure showed no statistically significant difference between the two groups. This could be explained by the fact that undergraduate students recently completed their pre-clinical requirements on complete and partial dentures, which included training on the facebow transfer procedure. At this point, no other studies looked at the association of PAL with the time required to complete facebow transfer.

There was an increase in the average score between the pre-seminar and post-seminar tests, indicating a positive outcome from the undergraduates' PAL exposure with the postgraduate students. Given the familiarity with the pre-test questions, this may suggest heightened attentiveness during the seminar. The students may be more aware of the questions or

areas about which they are uncertain; as a result, they are more attentive to finding the answers.

The students' responses to the close-ended questions from the questionnaire showed they were highly receptive to this learning approach. This may be because of the more relaxed way of learning from peers that allows the students to be more comfortable asking questions.

The thematic analysis highlighted a predominantly positive reception towards PAL, emphasising its value in knowledge acquisition and clinical skill enhancement and bolstering communication abilities and confidence. In the literature, peer relationships have a different dynamic than expert-student ones because peers can relate to each other on a level where it is safe to make mistakes, ask questions, and voice concerns while receiving timely, honest, and constructive feedback (12). According to another research, students who acquired explanations were better able to fill in knowledge gaps, dispel misconceptions, and capture new, lasting knowledge (13). Contrarily, some frustrations arose, primarily around perceived subordinate roles as assistants, accessibility to peers, and perceived time constraints. Although PAL sessions were considered time-consuming, literature reported that peers appeared to benefit more from the experience (12).

There are limitations to this study. The fourth-year students have just been exposed to the procedures during pre-clinical and clinical sessions, so the results of the two groups may not differ significantly. Another limitation is that clinical hand skills vary between students. It is difficult to standardise what the students observe during each PAL session, hence the exposure between different sessions varies. On top of that, during PAL sessions, the students may observe one or both of the two procedures or none of the procedures at all.

Conclusion

This study found no significant correlation between PAL and students' clinical performances. However, students have generally perceived the positive benefits of this learning approach in enhancing knowledge and clinical exposure. Therefore, with a thorough and structured learning plan, PAL is recommended to be implemented and integrated into the dental school curriculum.

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Competing interests

The authors declare no conflict of interest.

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