ORIGINAL ARTICLE

IMPACT OF PROBLEM-BASED LEARNING ON KNOWLEDGE ACQUISITION AMONG DENTISTRY STUDENTS

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ABSTRACT

The aim of the study was to assess if problem-based learning produced a better impact on knowledge acquisition than traditional lecture methodology in the teaching of dentistry. A pilot study was carried out at Bahria University Medical and Dental College from May 2016 to January 2017. The study involved forty one students of third year BDS divided into two groups, PBL group and Lecture group. Each group contained a homogenous mix of high achievers and average students. Each of these groups was taught four topics of their course with problem-based learning and traditional lecture methodology respectively. The students were then put through a multiple choice questionnaire and viva voce session to assess their factual knowledge, comprehension and application in clinical cases. The multiple choice questions were categorized as recall, interpretation and problem-solving. The scores were recorded using MS Excel 2013 and SPSS 17 and Chi square was applied to compare the results of the two groups. P-values less than 0.05 were considered significant. The total score in multiple choice questions for the PBL group was 62% whereas for the lecture group it was 64%. Students from both the groups scored 77.8% in the recall category. In interpretation, the PBL group scored 55.6%, while the Lecture group scored 47.2%. In problem-solving, the Lecture group scored 77.8%, while the PBL group scored 55.6%. In the viva voce, students from the PBL group scored 61.1% while the Lecture group counterparts scored 57.2%. Chi-square analysis produced p-values greater than 0.05 in all categories, total multiple choice questions score as well as viva voce. Within the limitations of this study, it can be concluded that students taught through problem-based learning produce similar results as students taught by lecture methodology in the teaching of dentistry.

Key Words: *Problem-based learning (PBL), traditional lecture methodology, knowledge acquisition, multiple choice questions (MCQs), viva voce, recall, interpretation, problem-solving.*

INTRODUCTION

Problem Based Learning (PBL) was introduced in medical education in 1976 by Howard Barrows, MD, at McMaster University, Canada. Beginnings of PBL can be traced back to John Dewey's philosophy of education published in the early twentieth century.[1] Dewey advocated engaging the learner in everyday problems to facilitate learning. Emphasis is placed on inquiry and self-directed, student-centered activities.[1] PBL revolves around some basic concepts which are:-

- The students are taught by creating case scenarios or "problems" about the course content. The students then use these cases to identify their learning needs and explore the various ways they can cover the subject area in the context of the case.
- Students are taught in the form of small groups instead of large classroom teaching. The purpose is to create a student centered approach in which students take an active role in the learning process.
- Teachers act as "facilitators" who help to streamline the learning process for the students instead of lecturing course content to them.
- Authenticity[3] forms the basis of problem selection. The problems presented to the students are well-aligned with the professional needs or "real-world" practice. They can be cross-disciplinary and allow the students to explore multiple subjects in order to generate a workable solution.

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Received for Publication: March 22, 2017
Revised: May 31, 2017
Approved: May 31, 2017

Various studies have reported greater student enthusiasm, participation, team-work and positive student attitudes with PBL teaching.[1,2,3] Yet research into whether PBL students do better in understanding and covering their course content has yielded mixed results. Moreover, studies about the efficacy of PBL methodology in dentistry are few and far between. In Pakistan too, PBL has not been actively explored as a teaching modality for dentistry. This study aims to investigate the effect of PBL on learning outcomes based solely on the knowledge of course content in dentistry students.

METHODOLOGY

For the purpose of this research, a pilot study was carried out at Bahria University Medical and Dental College from May 2016 to January 2017. Forty one students from third professional BDS were included. Inclusion criterion was all students who had cleared their second year BDS exams. Students were divided equally into two groups. One group was designated as the Lecture Group and the other as the PBL group. The ages of all participants were noted and the mean age of the students was calculated to be 21 years. In order to ensure that each group contained a uniform mix of high achievers as well as average students, a record of the students' academic scores in first year BDS and second year BDS was retrieved. Students were sorted in such a manner that both the groups had a mix of high achievers as well as average students.

Lecture Group students were taught using traditional lecture methodology whereas PBL Group counterparts were taught the same topics in a PBL format consisting of "problems" or case scenarios pertaining to the topic of the study and the corresponding "triggers" and "tasks". The topics selected for the study included Localized Alveolar Osteitis (Dry Socket), Syncope, Temporomandibular Pain Dysfunction Syndrome and Tooth Avulsion.

After the completion of the lectures and PBL sessions, students were given a multiple choice questionnaire related to the topics covered and their scores were recorded. The multiple choice questions were designed in recall, interpretation and problem solving format to assess factual learning, comprehension of concepts and clinical problem solving respectively. Next, students went through a viva voce regarding the same topics.

MS Excel 2013 and SPSS 17 were used to record data and to carry out statistical analysis. The students were scored with sums and frequencies of total mcqs score, recall, interpretation and problem-solving. Chi square test was applied to compare the scores of the two groups. A p-value less than 0.05 was considered significant.

RESULTS

The sample comprised of a total of 41 students out of which 21 students belonged to the Lecture group and 20 students belonged to the PBL group. All participants were between the ages of 20 and 22 years. The mean age of the students was found to be 21 years. The results of the multiple choice questions showed that the total MCQs score for Lecture Group students was 64% whereas the same for PBL group students was 62% (Table 1) The results from the viva voce showed that students from the Lecture group scored 57% whereas students from the PBL group scored 61% (Table 1).

The multiple choice questions were further categorized as Recall, Interpretation, and Problem-solving and scores calculated. In the Recall category, students from both the groups scored 77.8%. In the Interpretation category, the Lecture Group students scored 47.2% whereas the PBL Group students scored 55.6%. In the Problem-solving category, the Lecture Group students scored 77.8% whereas the PBL Group students scored 55.6%. (Table 2)

Chi-square test was applied to compare the results of Lecture Group and PBL Group. When the total MCQs score was compared, p was found to be 0.453. In the viva scores, a p-value of 0.599 was found. In the recall category of multiple choice questions, a p-value of 0.134 was produced. In the interpretation category, p was 0.910. In the problem-solving category, Chi-square produced a value of 0.719 Hence all readings were more than 0.05.

DISCUSSION

Proponents of PBL claim that group learning not only facilitates the acquisition of knowledge but also promotes soft skills in students like respect for others, team work, confidence and communication skills. They learn to take responsibility and how to work independently without traditional teacher support.[1,4,5,18,19,20]

In this study, the two groups of students produced similar results. When the total scores for multiple choice questions were compared, the lecture group achieved 64% marks while the PBL group achieved 62% marks. Similarly, in the recall category, students from both groups achieved 77.8% marks. From these results, it may be reasoned that the ability to learn facts and reproduce them is independent of the type of teaching methodology introduced. Also, the pros of studying in a problem based environment have to be weighed with the anxiety and stress that follows deviation from a more predictable traditional lecture format. Greenwood in his study carried out at the University of Adelaide shows that students find it difficult to decide when to stop researching a topic and how to balance between solo and group study.[6]

Similarly, in the interpretation category, lecture group students scored 47.4% while their PBL counterparts scored 55.6% marks. Along similar lines, students from PBL group scored 61.1% in the viva voce whereas the Lecture group students scored 57.2%. This difference may be attributed to the fact that PBL students learn in groups, discuss the key terms of their cases among peers and have to consult multiple learning resources for their assignments.[22] They may have more data at their disposal regarding a topic than their peers. However,

these very reasons may prevent them from developing the clarity and confidence in problem-solving that is gained through an instructor delivering a lecture. Instructors often elaborate on difficult concepts better and bring a better understanding to clinical cases. In situations where students consult different books and authors for clinical situations, there is a greater chance for students to misconstrue concepts or to have differing concepts. Therefore, in the problem-solving category, PBL students scored 55.6% while the Lecture group students scored 77.8%.

From a statistical viewpoint, these differences in scores were found to be insignificant. Chi-square produced a p-value greater than 0.05 in all the categories compared for the two groups. However, an obvious limitation of this study was the small sample size and a short duration allocated for the study. A larger sample size and/or a follow-up of the study over time could have produced different results.

A similar study carried out in Iran in 2014 showed that the median score of the students in the group exposed to PBL was higher than the lecture group.[22] However, statistically, the difference was not significant. Students prefer PBL due to higher motivation levels and team-work.[2,3] Still, knowledge levels were not affected significantly. A similar study carried out on house-officers in Birmingham showed that learning outcomes were similar in PBL and LBL.[23] A study carried out in Pakistan by Khan H et al on medical students comparing PBL and LBL concluded that both groups showed similar levels of knowledge.[24]

In Hong Kong, a study by Johnston was carried out as a randomized controlled trial to compare PBL with LBL.[25] This study concluded that PBL was less effective than LBL in imparting knowledge than customary LBL. Similarly, in Germany, a study on PBL comparing facilitative versus non-facilitative tuition in endodontics revealed a slightly larger knowledge gain in the non-facilitative traditional methodology group.[21] However PBL students showed greater activity and motivation.

In a study comparing the effects of PBL with traditional methodology in dental alveolar surgery course, a 3 year follow-up revealed both PBL graduates and their supervisors rated the level of clinical preparedness as better with PBL.[26] However, there were no significant differences between the graduates' habits or life-long learning attitudes.

In China Medical University School of Stomatology, students taught by PBL scored better in case analysis, didactic tests, practical tests and total scores whereas LBL group was better in theoretical scores.[27] There was significant difference between the two groups. In another study conducted in India by Rekha K, a comparison of final year students of dentistry divided into two groups revealed that the PBL group scored significantly higher than the lecture group in their academic performances through an internal assessment examination.[28]

In this regard, the findings of a systematic review of literature on this subject carried out at The Harvard School of Dental Medicine in 2013 are worth noting.[29] The study found no significant differences between the two groups of teaching in terms of general dental knowledge, pre-clinical skills, clinical skills, communication with staff and patient education. Significant differences were found in independent learning, critical thinking, team work and self-assessment. Many studies exploring the subject of PBL in dental education demonstrate contradictory results regarding its effectiveness. While some studies suggest that PBL does not negatively influence knowledge acquisition in students[1], significant improvement as compared to traditional methods is not found. In the medical education literature, some studies have actually questioned the role of PBL in factual learning and state that PBL has a negative influence on students' factual knowledge. Others however are of the opinion that PBL students perform better in applying their knowledge to clinical scenarios and perform better in standard exams like the National Board Dental Exam.[2,3,5,6]

There are other issues that may affect the implementation of PBL programs and make it difficult to reach a consensus on the issue. First of all, the broad definition and inconsistent interpretation of PBL pose a challenge in all studies.[2,5,17] The quality of the cases presented for PBL, the level of training of the facilitators and the available infrastructure and facilities for the students may all affect the outcome.[16] Also, some studies are about evaluation at a single course level while others are about a curriculum-wide approach.[16,17] This may introduce limitations regarding assessment and evaluation.

In the South Asian context, "Practice of Problem-based Dentistry in India", a survey was carried out in 2015 to find out the knowledge and practice of PBL among dental faculty in India.[7,8] The study showed that most faculty were aware of PBL teaching methodologies but were not carrying it out in their institutions. The research concluded that measures should be taken by the regulatory body to introduce PBL as an important tool in dental school curriculum in India.[7] A similar situation has been observed in Iran, Nepal and Pakistan[11,12,13,14] with a dearth of literature describing PBL experiences in undergraduate dentistry education.[10]

The available literature on PBL in Pakistan addresses mostly medical education.[9,10,11,12,13,14,15] The challenges facing PBL implementation here are almost the same as around the world.[12] Many studies demonstrate that a pure PBL program leaves voids that can only be filled by conventional teaching methodologies.[11,12,16,14] However, more research is required to determine the modalities of implementation.

CONCLUSION AND RECOMMENDATIONS

In this study, we found that students taught by problem-based learning produced similar results in knowledge acquisition as compared to students taught by traditional lecture-based approaches. However, more

research is required with larger sample sizes, inclusion of a number of professional years and a cross-institutional approach to reach a result. Also, the areas in which PBL can be effective on its own and those in which a hybrid approach is required need to be identified. For a comprehensive transition to PBL throughout the curriculum, a complete structural change is required which supports this teaching methodology. Beginning from selection and organization of faculty to training workshops, continuous evaluation, designing a quality PBL curriculum and arranging resources, a program well-suited to learning objectives can be created.

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