RESEARCH ARTICLE

Performance and preference of problem-based learning (PBL) and lecture-based classes among medical students of Nepal

[version 1; peer review: 2 approved with reservations]

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Abstract

Background: PBL (problem based learning) is new active learning educational strategy that has been extensively tested and used in recent years. This study aims to compare students' understanding and knowledge retention when taught through PBL and lecture-based classes and compare PAHS students' perceptions of PBL and lectures in medical education.

Methods: This is a cross-sectional study of medical students of a PBL based medical school in Nepal, a non-Western low-income country. Ethical approval was given by the institutional research committee of the Patan Academy of Health Sciences. Understanding and knowledge retention was assessed with 50 vignette-based multiple-choice questions, half of which were taught through PBL sessions, and the remaining half were taught in didactic lectures during basic science years of medical school. A separate pre-validated perception questionnaire was used to assess students' preferences regarding PBL and lectures.

Results: Out of 107 students, 99 participated in the understanding and knowledge retention questionnaires and 107 completed perception questionnaires. Understanding and knowledge retention of students was found to be the same for topics taught by PBL and lectures, with median scores of 17 and 16, respectively. PBL were mostly preferred for the physiology (59.81%), pathology (51.40%) and pharmacology (53.27%) concepts, and lectures were mostly preferred for the anatomy (78.50%), biochemistry (45.79%), and microbiology (42.99%) topics. Students wanted the same concepts to be taught through both PBL and lectures, especially for anatomy.

Conclusions: Understanding and knowledge retention is the same for

Open Peer Review

Approval Status ? ?

	1	2
version 2 (revision) 27 Apr 2022		 view
version 1 14 Feb 2022	 view	 view

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Trivandrum, India
2. **Babu Raja Maharjan** , Patan Academy of
Health Sciences, Lalitpur, Nepal

Any reports and responses or comments on the article can be found at the end of the article.

topics taught by either PBL or lectures during the basic science years of undergraduate medical education. Students prefer PBL for physiology, pathology, and pharmacology-related concepts, conventional didactic lecture for physiology and microbiology, and a combination of lecture and PBL sessions for anatomy.

Keywords

medical education, undergraduate medical education, medical school, lecture-based classes, problem-based learning, PBL

This article is included in the **Research on Research, Policy & Culture** gateway.

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Author roles: **Adhikari Yadav S:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Software, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Poudel S:** Formal Analysis, Investigation, Methodology, Resources, Software, Supervision, Validation, Visualization, Writing – Original Draft Preparation, Writing – Review & Editing; **Pandey O:** Conceptualization, Data Curation, Formal Analysis, Investigation, Project Administration, Software, Supervision, Validation, Writing – Review & Editing; **Jaiswal DP:** Conceptualization, Data Curation, Formal Analysis, Investigation, Methodology, Project Administration, Resources, Software, Supervision, Validation, Writing – Original Draft Preparation, Writing – Review & Editing; **Malla BP:** Conceptualization, Data Curation, Formal Analysis, Methodology, Project Administration, Resources, Software, Validation, Writing – Review & Editing; **Thakur BK:** Conceptualization, Data Curation, Formal Analysis, Funding Acquisition, Methodology, Project Administration, Supervision, Validation, Writing – Review & Editing; **Gautam S:** Formal Analysis, Investigation, Methodology, Resources, Software, Validation, Writing – Review & Editing; **Pandey SR:** Formal Analysis, Investigation, Methodology, Resources, Software, Supervision, Validation, Writing – Review & Editing

Competing interests: Authors have been involved as members, tutors or volunteers of PBL and lecture sessions at PAHS. The authors declare that they have no competing interests otherwise.

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Introduction

Sir William Osler, referred to as the father of modern medicine, emphasized the role of teachers in helping students to observe and reason. He recommended for teachers to abolish the traditional lecture method of instruction.¹ PBL (problem-based learning) is a newer active learning educational strategy that has been extensively tested and used in recent years.² PBL is an integral part of teaching in the undergraduate medical education of several medical schools around the globe, including Patan Academy of Health Sciences (PAHS), a government medical school of a non-Western LIC (low-income country), Nepal.² The PBL process was pioneered by Barrows and Tamblyn at the medical school of McMaster University in Canada in the 1960s.³ Students like PBL because it is student-focused, allows active learning, and leads to better understanding and retention of knowledge.^{4,5}

Students take more interest and responsibility for learning, look for resources like research articles, journals, internet, textbooks, etc. and themselves resolve the contextual problems given in PBL.⁶ PBL enhances content knowledge and simultaneously fosters the development of communication, collaboration, problem-solving, critical thinking, and self-directed learning.^{7,8} PBL emphasizes lifelong learning by developing the potential to determine goals, locate appropriate resources, and assume responsibility for what one needs to know.⁹ It helps students for long-term knowledge retention and improves competency as physicians after graduation.^{10,11} PBL has gradually been adopted by several medical schools around the globe for undergraduate education.^{12–14}

PBL encourages students to ask questions, search references, and think of logical answers. On the other hand, PBL is resource-intensive and requires more physical space, computer resources, and more staff to facilitate PBL sessions.¹⁵ Students also report uncertainty, information overload, and inability to determine the required depth and relevance of information available.¹⁵ This study aims to compare students' understanding and knowledge retention of topics taught through PBL and lectures, and also compare students' perception of PBL and traditional lectures, among the first two batches of medical students of PAHS who passed in 2016 and 2017.

Methods

Study design and participants

This study is a cross-sectional study performed in Nepal, a non-Western low-income country, among medical students of PAHS, where the hybrid PBL method is used during basic science years. All of the selected two batches of PAHS medical students were included in this study with their written informed consent. Students who did not give consent, students among the researcher team of this study, and students who participated in the pilot survey of questionnaires developed for this research were excluded from the study. The developed questionnaires were administered to 15 students who were randomly selected in the pilot study, to establish the validity and feasibility of these. They were asked in detail about the questionnaire and any suggestions for revisions or editing needed. The pilot survey did not undergo any statistical comparisons. Only a few grammatical corrections were made after review and feedback from the pilot study. Subsequently, the final study was conducted. Ethical approval was given by the Institutional Research Committee (IRC) of PAHS (IRC-PAHS) and research was carried out per relevant guidelines and regulations.¹⁶

Tools: validation, implementation, and analysis

Multiple-choice questions (MCQ) were used to assess understanding and knowledge retention, whereas a separate questionnaire was used to assess the preference for PBL and lectures.²⁵ The MCQ questionnaire for the assessment of understanding and knowledge retention had a total of 50 vignette-based MCQs, half of which were from topics taught through PBL, and the remaining half were from topics taught through lectures. These MCQs were developed and validated by the students with the help of research advisors. The MCQ scores were converted into percentages and interpreted in terms of percentage: <60% = very low, 60-70% = low, 70-80% = moderate, 80-90% = high and 90-100% = very high. The perception questionnaire was compiled and discussed in the student research group and reviewed by the research advisors to establish content validity. It was administered to the 15 students to establish the face validity and feasibility. The perception questionnaire had 30 questions to be answered on a forced Likert scale, ranging from one (strongly agree) to four (strongly disagree). Students were allowed to explain or give opinions qualitatively in some questions of the perception questionnaire. Data entry and editing were done in a MS Excel spreadsheet and analyzed in the SPSS 13.0 software for Windows. Descriptive statistics (mean and percentage) and inferential statistics were used to compare perception. A p-value less than 0.05 was taken as a statistically significant result.

Results

Basic characteristics and information

Out of 107 students, 99 completed the understanding and knowledge retention questionnaires.²⁵ The mean age of the participants was 22 years. In total 59.6% of respondents were male and 40 (40.4%) were female. The majority (67/99 i.e., 67.7%) of respondents have completed their schooling at a private school and 32 (32.3%) completed their schooling

at a public school. About half (49.5%) were living in urban areas while 24 (24.2%) and 26 (26.3%) were from semi-urban and rural areas, respectively. The majority (91 i.e., 91.9%) of the respondents were from a 10 + 2 high school science background, while only 8 (8.1%) were from 10 + 3 health sciences background.

Understanding and knowledge retention of students

The normality test showed that the marks obtained by participants on topics taught via PBL and topics taught via lecture were not normally distributed (Shapiro-Wilk p-value = 0.015 for lectures and 0.024 for PBL). Thus, the median score was computed, which was 16 for lectures and 17 for PBL, as shown in [Table 1](#).

Perception of students

The perception scale was found to be internally consistent as the coefficient alpha of the perception questionnaire was 0.893. Students mostly preferred physiology, pathology, and pharmacology-related concepts through PBL whereas they preferred anatomy, biochemistry, and microbiology-related topics through lectures. Some students wanted to be taught via both PBL and lectures, especially for anatomy subjects ([Table 2](#)).

Neither PBL nor lectures were preferred for Community Health Science (CHS) and Introduction to Clinical Medicine (ICM) where many opted not to respond. Regarding CHS, students mentioned they learn public/community health better in community postings and lecture sessions with a group of faculty members as a part of Community-Based Learning Education (CBLE). Regarding ICM they prefer it on hospital wards and bedside teaching.

Discussion

This study showed that students mostly liked being taught by both PBL and lectures. PBL was preferred for physiology, pathology, and pharmacology-related concepts, lectures were preferred for biochemistry and microbiology-related topics, and a combination of both for anatomy. Overall, the respondents wanted to be taught the same concepts via both PBL and lectures for anatomy. A meta-analysis by Nandi *et al.* compared the newer PBL curriculum and the conventional lecture-based mode of teaching undergraduate medical students. They concluded that a combination of both the conventional lecture-based and newer PBL curricula would provide the most effective training for undergraduate medical students.¹⁷ However, their findings were not subject-specific.

Table 1. Multiple choice question (MCQ) median score by two teaching methods at Patan Academy of Health Sciences, Nepal.

	Lecture	Problem-based learning (PBL)
Total MCQs	25	25
Median score	16	17
Mann-Whitney U test	-0.706	
p-value	0.48	

Mann-Whitney U test was not statistically significant (p-value: 0.48), there was no difference in the median marks obtained in PBL and lecture methods.

Table 2. Subject preference to be taught using problem-based learning (PBL) and lectures (N = 107).

Subject	Preference for PBL (%)	Preference for lectures (%)	Preference for both (%)	No response (%)
Physiology	64 (59.81%)	50 (46.73%)	7 (6.54%)	0
Pathology	55 (51.40%)	53 (49.53%)	1 (0.93%)	0
Pharmacology	57 (53.27%)	48 (44.86%)	2 (1.87%)	4 (3.74%)
Anatomy	61 (57.01%)	84 (78.50%)	38 (35.51%)	0
Biochemistry	43 (40.19%)	49 (45.79%)	5 (4.67%)	20 (18.69%)
Microbiology	30 (28.04%)	46 (42.99%)	2 (1.87%)	33 (30.84%)
Introduction to Clinical Medicine (ICM)	29 (27.10%)	40 (37.38%)	2 (1.87%)	40 (37.38%)
Community Health Sciences (CHS)	21 (19.63%)	35 (32.71%)	1 (0.93%)	52 (48.60%)

Note: For multiple response items, respondents were allowed to select PBL or lecture or both.

This study showed understanding and knowledge retention of students remained the same for topics taught by PBL compared to topics taught by lecture. There was no statistical difference in the median score obtained for PBL and lectures for the understanding and knowledge retention questionnaire (17 and 16, respectively). However, most other studies show better understanding and knowledge retention with PBL than lectures. A study by Albanese *et al.* showed that the PBL students score higher than the students in traditional courses. They also concluded that the reason for higher scores in PBL are the learning competencies, problem-solving, self-assessment techniques, data gathering, behavioral science, etc. of PBL students.¹⁸ Similarly, a study from Pakistan showed the mean score in the group exposed to PBL was 3.2 ± 0.8 while those attending lecture based classes was 2.7 ± 0.8 ($p = 0.0001$).¹⁹ Another study on students of mathematics from Slovenia found that students exposed to PBL were better at solving more difficult problems.²⁰

This study involved students taught through PBL in the first and second year of medical school i.e. basic science years and showed equivalent results compared to lectures. However, another study on PAHS students showed that PBL imparts long-term knowledge retention through students' active participation.²¹ Wun *et al.* have also found that PBL which is started in the initial years of medical school is associated with more active participation, interaction, and collaboration among students, and PBL students score higher too.²² Another study on nursing students found that all students with higher or lower grades showed a significant increase in scores among students in the PBL group, but only students with higher grades showed a notable increase in scores among students in the lecture group. Learning motivation was also found to be significantly higher in the PBL group ($t = 2.608$, $p = 0.012$).²³

A few of the respondents qualitatively reported in this study that some students in the PBL group worked harder than other members of the same group to prepare and participate in discussions. They also found the time allocated for each topic was not sufficient at times. Silva *et al.* reported that teamwork and the time involved are factors which can limit PBL learning.²⁴ According to Wood, major disadvantages to this process involve the tutor facilitation and utilization of excessive resources.¹⁵

Conclusion

The understanding and knowledge retention of students is the same for topics taught by PBL compared to topics taught by conventional didactic lecture. PBL is preferred for physiology, pathology, and pharmacology-related concepts, whereas conventional didactic lectures were preferred for biochemistry and microbiology-related topics, and a combination of lecture and PBL sessions were preferred for anatomy during the basic science years of undergraduate medical education. Students prefer community-based programs and lecture sessions delivered by a group of faculty members for CHS. In contrast, they prefer a bedside teaching and hospital ward-based teaching methodology for ICM rather than lectures and PBL.

Data availability

Underlying data

Figshare: Raw data and Questionnaire of research "Performance and Preference of Problem-Based Learning (PBL) and Lecture-Based Classes Among Medical Students of Nepal." <https://doi.org/10.6084/m9.figshare.17286902.v1>.²³

This project contains the following underlying data:

- Raw Data of PBL Research.xls
- Descriptive Analysis of PBL Research.doc

Extended data

Figshare: Raw data and Questionnaire of research "Performance and Preference of Problem-Based Learning (PBL) and Lecture-Based Classes Among Medical Students of Nepal." <https://doi.org/10.6084/m9.figshare.17286902.v1>.²³

This project contains the following extended data:

- Preference questionnaire of PBL Research.doc
- Understanding questionnaire by MCQ of PBL Research.docx

Data are available under the terms of the [Creative Commons Attribution 4.0 International license](#) (CC-BY 4.0).

Acknowledgements

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Current Peer Review Status: ? ?

Version 1

Reviewer Report 20 April 2022

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Babu Raja Maharjan

Department of Biochemistry, School of Medicine, Patan Academy of Health Sciences, Lalitpur, Nepal

This paper follows the IMRAD guidelines. Abstract and introduction is well written. But the limitations of the study need to be stated and following comments need to be addressed before indexing.

Perception questionnaire was mentioned in the research method, but its finding was not described in the result section. Please provide a reason for this inconsistency.

It is not stated when the questionnaire and MCQ test was administered. Recall bias will be there if it is administered a long time after the completion of basic science years where PBL is being implemented. This in turn will affect the measurement of performance by MCQ score and preference of PBL/Lecture for various subjects. Therefore, it should be clearly mentioned as the limitation of the study and current finding is based on students preference and performance of PBL measured after ?? time period.

Furthermore, the drawing of comparative inference on the preference of subjects for either PBL or Lecture is inappropriate. Questionnaire that was used in the study independently asked the preference of subjects for PBL and Lecture to the participants hence inference cannot be drawn if a certain subject has been preferred more or less for PBL over lecture. With the given study design, valid inference that can be drawn will be just the preference of various subjects to PBL and the preference of different subjects to Lecture but not comparison between PBL and lecture for a subject as mentioned in discussion and conclusion.

In discussion section, all of a sudden there is presentation of qualitative findings while it was neither mentioned in method section or result section. This needs to be consistent.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Partly

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Partly

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Health Professions Education, Obesity, Adipocyte Biology, Insulin resistance, Diabetes

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 22 Apr 2022

Saroj Adhikari Yadav

Dear Dr. Maharjan,
Thank you for your comments and suggestion.
Regarding your comments and reservation-

1. I am including your feedback and uploading a new version of the manuscript.
2. Preference data is included in the 3rd and 4th paragraphs of the results.
3. Data were collected before the 1st and 2nd batch graduated in 2016 and 2017. So, I assume, recall bias should not be that significant. I am including this in the updated version of the manuscript.
4. We have mentioned in the 2nd paragraph of the method section that "Students were allowed to explain or give opinions qualitatively in the perception questionnaire."

Thank you once again.

Competing Interests: No competing interests were disclosed.

Reviewer Report 01 April 2022

<https://doi.org/10.5256/f1000research.118167.r126411>

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Mamata Chimmalgi

Department of Anatomy, Sree Gokulam Medical College and Research Foundation, Trivandrum, Kerala, India

Saroj Adhikari Yadav et al. in their article 'Performance and preference of problem-based learning (PBL) and lecture-based classes among medical students of Nepal' have compared the learning outcome following PBL and didactic lecture and assessed preference of the students regarding the two methods. The article is written adhering to IMRAD structure and elaborates the findings of a cross sectional study conducted in PAHS in Nepal.

- Abstract is structured and draws attention to the aims of the study and the correctly drawn conclusions.
- Introduction segment enumerates the merits and challenges of PBL and proceeds to list the aims of this study in that context.
- Methods segment elaborates on inclusion and exclusion criteria; developing MCQ questionnaire and perception questionnaire; establishing validation of the questionnaire; implementation and analysis. However, time intervals between the T/L methods and the administration of the questionnaire may be added to understand whether immediate learning or long-term retention were being studied - although the discussion segment mentions another study at PAHS addressing the long term retention, the method followed in the current study is missing.
- In the Results segment, inference drawn regarding the performance may be included under 'understanding and knowledge retention of students' before proceeding to the results - e.g. 'learning outcome following PBL was similar to lecture' or 'students performance following PBL was comparable to performance following didactic lecture'.....
- Regarding perception of students - both in results and in discussion segments, other parameters assessed by the perception questionnaire - unless deliberately omitted - may be included.
- Conclusion segment effectively and correctly sums up the findings.
- Under References, is there a need to add the last reference by the authors (no. 25), when the same are shared under data availability?

Overall, a well-written, clear and concise article.

Is the work clearly and accurately presented and does it cite the current literature?

Yes

Is the study design appropriate and is the work technically sound?

Yes

Are sufficient details of methods and analysis provided to allow replication by others?

Yes

If applicable, is the statistical analysis and its interpretation appropriate?

Yes

Are all the source data underlying the results available to ensure full reproducibility?

Yes

Are the conclusions drawn adequately supported by the results?

Yes

Competing Interests: No competing interests were disclosed.

Reviewer Expertise: Anatomy, Histology and Medical education

I confirm that I have read this submission and believe that I have an appropriate level of expertise to confirm that it is of an acceptable scientific standard, however I have significant reservations, as outlined above.

Author Response 22 Apr 2022

Saroj Adhikari Yadav

Dear Dr. Chimmalgi,
Thank you for your comments and suggestion. I am including your feedback and uploading a new version of the manuscript.
Thank you once again.

Competing Interests: No competing interests were disclosed.

Comments on this article

Version 1

Reader Comment 22 Feb 2022

Rano Piryani

The abstract is structured with usual sub-headings: Background, Methods, Results, and Conclusions. Mentioned Keywords are as per MeSH terms.
Authors have followed IMRAD structure for writing this article (Introduction, Methods, Results and Discussion).

Authors have acknowledged the help of faculty members.
References are more less Vancouver Style and sufficient in numbers.
The link to data availability files are there to verify data.

In my opinion authors have to update the article and clarify the queries raised as follows:

Introduction:

Authors may mention same attributes of didactic lectures as this is comparative study between PBL and didactic lecture.
They have to add rationale of study the introduction.
Introduction need to be written in sequence.

Methodology

Authors have to mention duration of study
How the reliability of questionnaires was established.
Authors may mention what guidelines and regulations were followed.
They may mention number and date IRC.
Authors may mention briefly how MCQ were validated and clarify which group of students validated the MCQs and whether these were excluded from the study.
In one sentence brief about students research group whether of same batches or others.
In raw data sheet in several cells data is missing; nothing is mentioned in the data analysis about this.

Results

SD is missing in age.
Explain 10+2 and 10+3 schooling as everyone is not aware of this.

Discussion

Authors have to explain why there is difference in results in this study and other similar study conducted in PAHS.
Authors have to mention the limitations of study and include their recommendations in conclusion.

Others

Authors have to improve language of the article; mention conflict of interest and source of funding if any.

Competing Interests: I have no competing interest

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