

An Analysis of Medical Undergraduates' Performance on Problem-based Objective Written Questions Compared to Traditional Objective Written Questions on Circulatory System and Lymphoid Organs in Histology

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Received: 2 June 2026
Accepted: 15 June 2026
Published Online: 18 June 2026

Published by:
Gopalganj Medical College, Gopalganj,
Bangladesh

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DOI: 10.5281/zenodo.20741308

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ABSTRACT

Background: Histology is a fundamental component of undergraduate medical education, with assessment methods significantly influencing student learning and skill development. Problem-based objective written questions (PBQ) aim to assess higher-order cognitive skills, while traditional objective written questions (TQ) primarily evaluate recall and understanding. **Objective:** To compare medical undergraduates' performance in problem-based objective written questions and traditional objective written questions in histology, focusing on the circulatory system and lymphoid organs. **Methods & Materials:** This cross-sectional analytical study was conducted in the Department of Anatomy, Bangladesh Medical University (BMU), Dhaka, from September 2024 to August 2025. A total of 220 medical undergraduate students were included, with 110 students in the problem-based question (PBQ) group and 110 students in the traditional question (TQ) group. A structured test comprising 100 objective written questions was administered under standardized conditions. Only responses related to the circulatory system and lymphoid organs were analyzed. Data were analyzed using SPSS version 27.0, and statistical significance was set at $p \leq 0.05$. **Results:** The mean score of the PBQ group was 31.59 ± 19.29 , while the TQ group achieved a higher mean score of 38.48 ± 18.68 . The difference between the two groups was statistically significant ($p = 0.00$). The 95% confidence interval (-7.29 to -7.06) confirmed significantly poorer performance in the PBQ group compared to the TQ group. **Conclusion:** Medical undergraduate students performed significantly poorer in PBQ than in TQ in Histology, particularly on the circulatory system and lymphoid organs. These findings suggest that students may require greater exposure and training in problem-based assessment formats to improve their application-level cognitive skills.

Keywords: Histology, Problem-Based Questions, Traditional Questions, Circulatory System and Lymphoid Organs, Medical Undergraduate Students.

(The Insight 2026; 9(2): 461-465)

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INTRODUCTION

Medical education serves as the cornerstone of a nation's healthcare system by cultivating skilled and empathetic physicians to address changing health requirements; in Bangladesh, the quality of this education is particularly important given its rising population and specific healthcare challenges [1]. The curriculum seeks to combine fundamental medical sciences with clinical practice, yet ongoing revisions are essential to keep pace with developments in medical

education and enhance the readiness of upcoming physicians [2,3].

Human Anatomy is a crucial topic in initial medical training, encompassing microanatomy, macroanatomy, and developmental anatomy [4]. Histology, an important branch concentrating on microscopic structures, is crucial for training skilled physicians. As medical knowledge continues to advance, methods of learning are always changing [5]. In Bangladesh, medical training incorporates conventional teaching alongside certain problem-based learning (PBL)

aspects, whereas evaluations predominantly utilize MCQs and SAQs centered on recall and comprehension. While crucial, these techniques focus on memorization, whereas the primary objective is to cultivate the capacity to utilize knowledge in actual clinical scenarios [6].

Histology connects normal tissue architecture and disease alterations, rendering it vital in healthcare [7]. In histology, students frequently struggle to connect concepts with clinical practice and exhibit low motivation, since it is introduced early in the curriculum. PBL addresses this issue by connecting histology with actual clinical scenarios, promoting small-group discussions, self-guided learning, and the enhancement of clinical problem-solving abilities with instructor support [8].

A study on histology education methods revealed that students instructed with more interactive or problem-oriented techniques (such as virtual microscopy and contemporary learning approaches) demonstrated better performance and comprehension on histology evaluations than those taught using traditional methods, indicating that engaging, application-focused formats can enhance exam scores and educational results [9].

Research contrasting PBL with traditional or lecture-based teaching in fundamental medical science topics (such as anatomy and physiology) revealed notably higher exam scores in PBL cohorts, suggesting improved comprehension and application of concepts evaluated in written tests [10].

In Bangladesh, there is scarce research directly comparing histology evaluations, but associated local studies suggest patterns in student performance with innovative or problem-based approaches. A study on medical students views in Bangladesh revealed that students think problem-based questions enhance their reasoning and skills, indicating favorable attitudes toward integrating PBL into evaluations [11]. A study focusing on the circulatory system and lymphoid organs in histology revealed that medical undergraduate students scored much lower on problem-based objective written questions compared to traditional objective written questions, probably due to their unfamiliarity with the problem-based question even with curricular suggestions.

METHODS & MATERIALS

Study design

This was a cross-sectional analytical study conducted in the Department of Anatomy, Bangladesh Medical University (BMU), Dhaka, from September 2024 to August 2025. The study evaluated the performance of medical undergraduate students in histology, focusing specifically on the circulatory system and lymphoid organs.

Study population and sampling

The study was conducted among medical undergraduate students who had already completed their 2nd term final examination in Anatomy. Two medical colleges were selected using a convenience sampling technique. A total of 220 students were included in the study, with 110 students allocated to the PBQ group and another 110 students to the TQ group. Participants attending scheduled lecture sessions were enrolled and assigned into two groups using an odd-even numbering method. Students with odd numbers were allocated to the PBQ group, while those with even numbers were assigned to the TQ group.

Study materials and question development

Histology questions were prepared using *Junqueira's Basic Histology Text & Atlas (16th edition)* as the standard reference textbook. Only curriculum-relevant chapters were included.

For this manuscript, the analysis was specifically focused on:

- The circulatory system (Chapter 11)
- The immune system and lymphoid organs (Chapter 14)

Questions from these two chapters were developed in both PBQ and TQ formats using identical content areas. In the PBQ group, students performed 12 questions from in circulatory system and lymphoid organs compartment. In the TQ group, students also performed 12 questions from in circulatory system and lymphoid organs compartment.

A total of 100 PBQ and 100 TQ were prepared. The number of questions derived from each chapter was determined proportionately based on the relative page distribution of the textbook. Relevant subheadings and sub-subheadings were selected using a lottery method to ensure unbiased content coverage.

Question format

Each assessment consisted of 100 objective written questions, including:

- 50 True/False type questions
- 50 Fill in the blank type questions

Problem-based questions were designed to assess application and clinical reasoning skills, whereas traditional questions assessed recall and comprehension levels.

Administration of the test

Students were grouped into PBQ and TQ cohorts. Each group received their respective question paper under standardized examination conditions. Adequate time was provided for completion, and strict examination discipline was maintained to ensure data reliability.

Data extraction and outcome measures

For this study, only responses related to the circulatory system and lymphoid organs were extracted from the full dataset. The primary outcome measure was the frequency of correct responses in PBQ and TQ groups.

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) version 27.0. The distribution of data was examined using the Shapiro-Wilk test to assess normality. Based on the data distribution, the ANOVA test was applied for comparisons between groups. A p-value <0.05 was considered statistically significant, and 95% confidence intervals were calculated.

Ethical considerations

The study was conducted after obtaining formal approval from the Institutional Review Board (IRB) of Bangladesh Medical University (BMU). Permission was also taken from the authorities of the selected medical colleges prior to data collection. Participation was voluntary, and informed written consent was obtained from all participants before the commencement of the study. The purpose and procedures of the study were clearly explained to the students, and confidentiality of all collected data was strictly maintained throughout the research process. The study posed no risk to participants and was conducted solely for academic and research purposes.

RESULTS

The study included medical undergraduate students who had completed their 2nd term final examination in Anatomy. A total of 220 students participated, with 110 students in the PBQ group and 110 students in the TQ group. The assessment

was conducted using both PBQ and TQ formats in histology, focusing on the circulatory system and lymphoid organs.

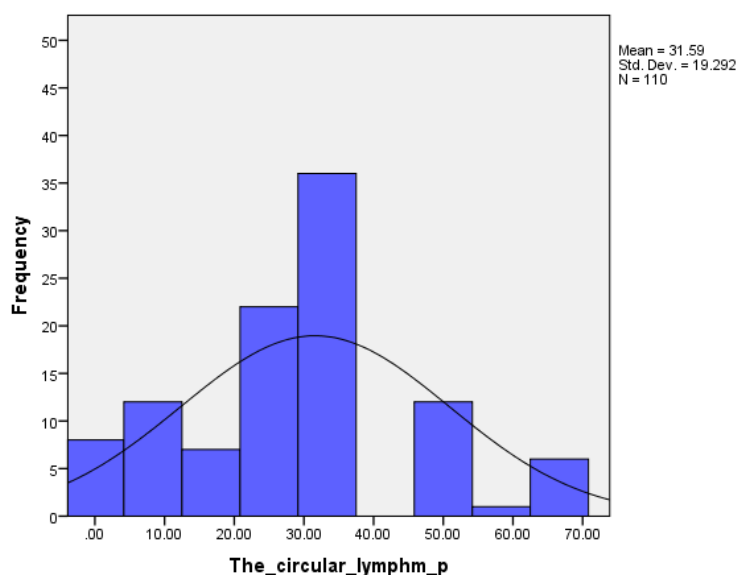


Figure 1: The frequency distribution of scores (no. of correct responses) of circulatory system and lymphoid organs in the 'PBQ' group of medical undergraduate students in histology.

As shown in *Figure 1*, in the PBQ group, the mean score for the circulatory system and lymphoid organs was 31.59 ± 19.29 ,

indicating comparatively lower performance in this compartment under a PBQ format.

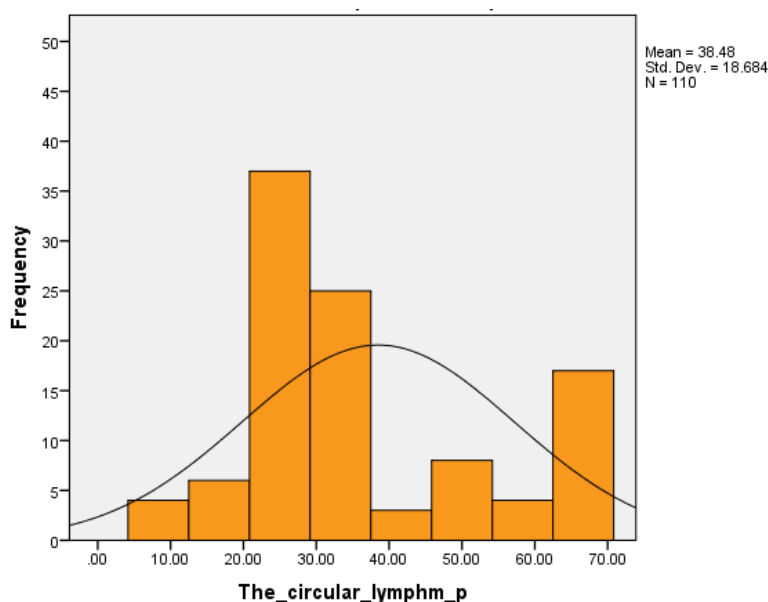


Figure 2: The frequency distribution of scores (no. of correct responses) of circulatory system and lymphoid organs in the 'TQ' group of medical undergraduate students in histology.

In contrast, *Figure 2* demonstrates that in the TQ group, the mean score for the same compartment was higher at 38.48 ± 18.68 , indicating better performance under the TQ format. A comparison between the two groups is presented in *Table I*. A statistically significant difference was observed between

PBQ and TQ ($P = 0.00$). The 95% confidence interval of the difference (-7.29 to -7.06) confirms that students performed significantly poorer in the PBQ than in the TQ group for the circulatory system and lymphoid organs.

Table I: Comparison of the Performance of Correct Responses Between PBQ and TQ on Circulatory System and Lymphoid Organs in Histology (n = 110 each group).

Compartment	PBQ Group	TQ Group	P-value	95% Confidence Interval of the Difference
	Mean $\pm$ SD; Median (25th, 75th percentile)	Mean $\pm$ SD; Median (25th, 75th percentile)		
Circulatory system and lymphoid organs	31.59 $\pm$ 19.29; 33.33 (25.00, 33.33)	38.48 $\pm$ 18.68; 33.33 (25.00, 50.00)	0.00	-7.29 to -7.06

P-value ≤ 0.05 was considered statistically significant (ANOVA test).

Overall, the results from *Figure 1*, *Figure 2*, and *Table I* demonstrate that students achieved poorer performance in PBQ compared to TQ on the circulatory system and lymphoid organs in histology.

DISCUSSION

The present study found that medical undergraduate students performed significantly poorer in PBQ compared to TQ on the circulatory system and lymphoid organs in histology, with mean scores of 31.59 ± 19.29 versus 38.48 ± 18.68 , respectively ($P = 0.00$). This finding aligns with several studies in the literature examining PBL versus traditional assessment methods in medical education.

The findings are consistent with previous evidence suggesting that students tend to perform better in traditional assessment formats when evaluating basic science knowledge. Similar observations have been reported in studies comparing problem-based and conventional assessment methods in medical education, where traditional approaches were associated with comparatively higher academic performance in foundational subjects such as anatomy and histology [12,13]. This may reflect the alignment of traditional questions with recall-based learning commonly emphasized in early medical curricula.

The lower performance in PBQs in the present study may also be related to increased cognitive demand and limited exposure to application-based questioning formats. Evidence suggests that problem-based assessments require integration, interpretation, and clinical reasoning skills, which may not be fully developed in preclinical students at early stages of training [14].

In contrast, several studies have reported better academic outcomes with problem-based learning approaches, particularly when integrated into structured curricula. These findings indicate that students exposed to problem-based learning may achieve higher performance in both theoretical and applied assessments, especially in higher-order cognitive domains [15,16]. However, such outcomes are often influenced by teaching design and learning environment.

The discrepancy between the present findings and studies favoring problem-based learning may be explained by differences in implementation and student familiarity. Evidence suggests that students perform better in problem-based environments when they receive adequate exposure and structured guidance, indicating that adaptation plays a key role in performance outcomes [17,18].

Furthermore, previous research highlights that although overall performance differences between problem-based and traditional methods may be minimal in some settings, students often require structured preparation to perform effectively in problem-based assessments [19]. It has also been emphasized that the success of problem-based learning depends on proper curriculum integration and learner readiness, which significantly influences learning outcomes [20].

Overall, the present study suggests that traditional objective questions remain more effective for assessing foundational knowledge in histology, whereas PBQs may better evaluate applied understanding when students are adequately trained and familiar with the format.

LIMITATIONS

Our study focused specifically on histology assessment on the circulatory system and lymphoid organs, which may limit generalizability to other medical subjects. Future research should examine whether similar patterns exist across different basic science disciplines and whether gradual introduction of problem-based assessment formats might improve student performance over time.

CONCLUSION

The present study demonstrates that medical undergraduate students perform significantly poorer on PBQ compared to TQ on the circulatory system and lymphoid organs in histology. While this finding aligns with several studies in basic medical sciences, it contrasts with research showing benefits of problem-based approaches in clinical contexts. These results suggest that careful consideration should be given to assessment format selection and that students may require specific preparation for problem-based question formats to optimize their performance.

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