

An Analysis of Medical Undergraduate Students' Performance on Problem-based Objective Written Questions Versus Traditional Objective Written Questions Concerning the Digestive System in Histology

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ABSTRACT

Background: Education fosters understanding, abilities, and the capacity to implement ideas, enhancing analytical thinking and issue resolution. Problem-based learning (PBL) encourages active, student-focused learning and clinical reasoning, although its effects on theoretical understanding remain contentious. Histology necessitates a solid conceptual grasp for practical clinical use. This research examines Problem-based Objective Written Questions and Traditional Objective Written Questions formats in histology of the digestive system to determine their efficacy in measuring student knowledge. **Methods & Materials:** This cross-sectional research at Bangladesh Medical University (BMU) (Sept 2024–Aug 2025) involved 220 medical students {110 Problem-based Question (PBQ) group, 110 Traditional Question (TQ) group} allocated by odd–even numbering. Utilizing validated and piloted questions from Junqueira's Histology, 100 Problem-based Objective Written Questions and 100 Traditional Objective Written Questions evaluated the digestive system, emphasizing application rather than recall. The exam lasting 90 minutes was carried out in a controlled environment, and the analysis of data utilized SPSS v27 with the ANOVA test ($p < 0.05$). **Results:** A total of 220 students (110 PBQ group, 110 TQ group) were evaluated. The average scores for both groups were comparable (PBQ: 46.92 ± 9.37 ; TQ: 46.36 ± 12.74) and their medians were the same [46.15 (38.46–53.85)]. The PBQ group exhibited a bit less variability, whereas the TQ group displayed more dispersion. Nonetheless, no statistically significant difference was observed between the groups ($p = 0.71$; 95% CI: -3.54 to 4.81), suggesting similar performance in both assessment

formats. **Conclusion:** There was no notable variation in students' performance between PBQ group and TQ group formats in digestive system histology, suggesting that both assessment methods effectively evaluate undergraduate knowledge.

Keywords: Medical undergraduate students, Problem-based objective Written questions, Traditional objective written questions, Digestive system, Histology.

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INTRODUCTION

Learning is a vital process that helps students to reach particular objectives by improving their knowledge and abilities. Learning is more successful when students are able to apply what they have learned in a variety of situations. This procedure fosters the growth of communication, problem-solving, and critical thinking abilities [1]. There has been increasing interest in identifying effective teaching and learning strategies, particularly those that promote active student engagement and deeper understanding [2].

PBL is an interactive, student-centered approach employed by 71% of pharmacy schools in the US, aiding students in acquiring problem-solving, evidence-informed decision-making, and communication skills vital for fundamental

competencies [3-6]. PBL emphasizes problem-solving over rote memorization, engaging students in active, relevant learning rather than passive, lecture-based instruction. Endorsed by the Association of Medical Colleges and the World Federation of Medical Education, it has been widely adopted in medical education over the past four decades [7].

PBL curricula improve clinical skills, but the effect on theoretical understanding is contested, with certain studies indicating knowledge deficiencies. Even with worldwide acceptance, the advantages of PBL compared to conventional lecture-based programs are still debated [7,8].

Histology, the study of the microscopic structure of tissues, is one of the fundamental fields that is essential to comprehending both normal physiology and

pathological processes, and eventually, disease mechanisms [9]. A solid grasp of histological structures is essential for the accurate interpretation of pathological changes and subsequent diagnosis in clinical practice [10].

Evidence from global reviews suggests that PBL often produces knowledge acquisition outcomes equal to or better than traditional approaches while improving problem-solving, self-directed learning, and communication skills [11]. However, in the context of Bangladesh, studies have shown that medical students perform better on traditional clinical questions compared to problem-based questions, possibly due to limited experience in applying knowledge to clinical scenarios [12]. Histology assessments in Bangladesh predominantly utilize recall-oriented questions, with

minimal exploration of problem-based approaches. This study, therefore, aims to compare medical undergraduate students' performance on problem-based versus traditional objective questions in digestive system histology and to evaluate the effectiveness of these approaches in promoting comprehension and application skills.

METHODS & MATERIALS

Study Design

This cross-sectional analytical study was conducted in the Department of Anatomy, BMU, Dhaka, Bangladesh, from September 2024 to August 2025.

Study Population and Sampling

The study included medical undergraduate students who had completed their 2nd term final examination in Anatomy. Two medical colleges were selected through convenient sampling. A total of 220 students participated, with 110 students in the PBQ group and 110 students in 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.

Development of Assessment Tools

Assessment tools were developed from *Junqueira's Basic Histology: Text and Atlas (16th edition)*, a standard reference for undergraduate medical education. Questions were constructed from chapters

related to the digestive system, including the digestive tract and associated organs.

A total of 100 problem-based objective written questions and 100 traditional objective written questions 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. In the PBQ group, students performed 13 questions from in digestive system compartment. In the TQ group, students also performed 13 questions from in digestive system compartment.

Problem-based questions were designed using clinical or applied scenarios to assess higher-order cognitive skills, whereas traditional questions focused on recall and comprehension. Both formats included 'True/False' and 'Fill-in-the-blank' items.

Validation and Pilot Testing

The question sets were reviewed and validated by eight anatomists, including two medical educationists, to ensure clarity, relevance, and appropriateness. A pilot study was conducted among 20 students (10 in each group) to assess feasibility and timing. Based on the pilot findings, the final test duration was set at 90 minutes for 100 questions.

Data Collection Procedure

The assessment was conducted in a controlled lecture hall environment. Participants were briefed about the study and provided written informed consent prior to participation. The PBQ group received

problem-based questions, while the TQ group received traditional questions. Measures were taken to prevent communication among participants during the test.

Outcome Measures

Student performance was assessed based on the number of correct responses in digestive system histology questions. Scores were calculated as percentages of correct answers.

Statistical Analysis

Data were analyzed using SPSS version 27.0. Normality was assessed using the Shapiro–Wilk test and histogram visualization. Descriptive statistics were expressed as mean $\pm$ standard deviation and median with interquartile range. The ANOVA test was used to compare performance between the PBQ and TQ groups. A p-value <0.05 was considered statistically significant, and 95% confidence intervals were calculated.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Bangladesh Medical University. Permission was taken from the respective medical college authorities. Written informed consent was obtained from all participants, and confidentiality was strictly maintained.

RESULTS

A total of 220 medical undergraduate students participated in the study, with 110 students in the PBQ group and 110 in the TQ group.

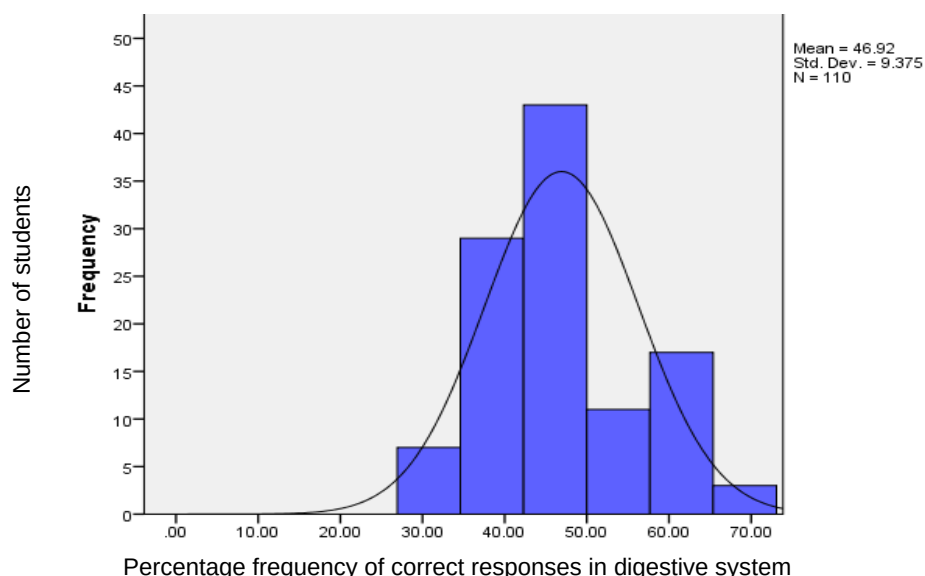


Figure 1 The frequency distribution of scores (no. of correct responses) of digestive systems in the 'PBQ group' of medical undergraduate students in Histology.

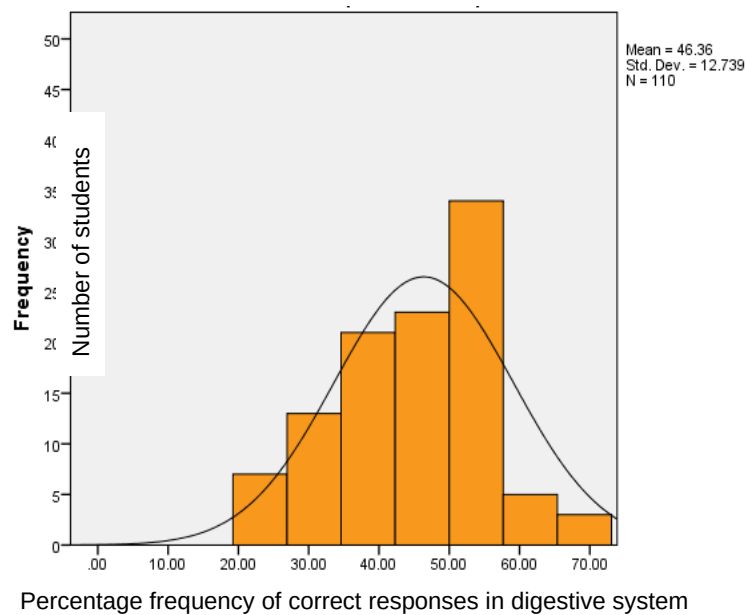


Figure 2 The frequency distribution of scores (no. of correct responses) of digestive systems in the ‘TQ group’ of medical undergraduate students in Histology.

Frequency Distribution

Figures 1 and Figure 2 illustrate the frequency distribution of correct responses. The PBQ group showed a near-normal distribution, with most students scoring between 38% and 54% (mean 46.92 ± 9.37), whereas the TQ group exhibited slightly greater variability (mean 46.36 ± 12.74), consistent with the higher standard deviation.

Comparison of Performance Between PBQ and TQ Groups

The comparative analysis of medical undergraduate students’ performance in digestive system histology is presented in Table I. The mean score in the PBQ group (46.92 ± 9.37) was slightly higher than that of the TQ group (46.36 ± 12.74). The median scores and interquartile ranges were identical in both groups [46.15 (38.46–

53.85)], indicating a similar central tendency and spread of scores. Statistical analysis revealed no significant difference in performance between the two groups (p = 0.71). Furthermore, the 95% confidence interval of the mean difference (-3.54 to 4.81) included zero, supporting the absence of a statistically significant difference between PBQ and TQ formats.

Table I

Comparison of Medical Undergraduate students’ Performance on Problem-Based Objective Written Questions versus Traditional Objective Written Questions in Digestive System Histology (n = 220).

Compartment	PBQ Group (n = 110)	TQ Group (n = 110)	P-value	95% Confidence Interval of Difference
Digestive System	46.92 ± 9.37	46.36 ± 12.74	0.71	-3.54 to 4.81
	46.15 (38.46, 53.85)	46.15 (38.46, 53.85)		

Overall, the findings suggest that there was no meaningful difference in students’ performance on digestive system histology questions when assessed using problem-based versus traditional objective written question formats. Both methods yielded comparable results in terms of mean scores, score distribution, and variability.

DISCUSSION

The PBQ group exhibited a more stable score distribution with reduced variability when contrasted with the TQ group, suggesting more consistent performance. This indicates that problem-oriented inquiries might enhance consistent learning results by promoting improved conceptual comprehension. These results align with Meo (2013), who indicated that PBL enhances engagement, critical thinking, and knowledge retention in contrast to

traditional methods. In general, PBQ seems to encourage steadier academic results compared to conventional question formats [13]. The research revealed no notable difference in performance between the PBQ and TQ groups regarding digestive system histology (p = 0.71), as their mean scores, medians, and variability were comparable. This indicates that both assessment types are similarly effective for measuring fundamental knowledge in this context. The results align with previous evidence indicating that PBL does not reliably enhance short-term knowledge results when compared to traditional teaching methods, even though it fosters deeper understanding and reasoning abilities. Norman and Schmidt (2000) found that PBL is equally effective as traditional curricula in acquiring knowledge, whereas Hmelo-Silver (2004)

highlighted its advantages in fostering meaningful learning, independent study, and problem-solving skills [14,15]. In general, PBQ group and TQ group formats exhibited similar effectiveness in evaluating knowledge, with PBQ group displaying a bit more consistency and possible advantages in encouraging deeper learning.

CONCLUSION

There was no notable difference in students’ performance between PBQ and TQ group formats in digestive system histology, suggesting that both assessment methods are equally effective in measuring undergraduate knowledge. Both methods showed similar results regarding average scores, score spread, and variability, indicating that either format can be utilized interchangeably for evaluating fundamental

conceptual comprehension in medical education without impacting overall student performance.

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