

**ORIGINAL ARTICLE**DOI: <https://doi.org/10.3329/mediscope.v10i2.67996>**Medical Undergraduates' Ability to Answer Problem-based Objective Questions Compared to Traditional Clinical Ones in Regional Anatomy*****F Yasmin¹, NF Amin²****Abstract**

Background: Anatomy is the most fundamental subject in undergraduate medical education and the curriculum is changing progressively for better outcomes for undergraduates. Clinical integration in learning Anatomy has been highlighted in the current curriculum. Therefore, analysis of the performance of the medical undergraduates on problem-based questions and traditional clinical objective questions on Regional Anatomy may provide an understanding of the recent teaching-learning-assessment trends in this subject and this type of research would help the teachers and curriculum planners to improve the teaching-learning-assessment pattern of Anatomy. **Objective:** To assess the ability of the medical undergraduates of Bangladesh to answer problem-based objective questions compared to traditional clinical objective written questions in Regional Anatomy. **Methods:** A total of 166 new third-year medical undergraduates participated in this research. Among them, eighty-three undergraduates participated to answer one hundred problem-based objective written questions and another eighty-three undergraduates participated to answer one hundred traditional clinical objective written questions in Regional Anatomy. The performance of the undergraduates was compared by the Mann-Whitney U test. **Results:** The performances of the medical undergraduates answering problem-based objective written questions were significantly poorer than those answering traditional clinical objective written questions. **Conclusion:** The result has shown that the performances of the medical undergraduates regarding problem-based objective questions are poorer than traditional clinical ones, most likely because they are not accustomed to the problem-based question, though it is the guideline of the curriculum. For better learning and assessment methods, the integration of problem-based questions is highly recommended in Regional Anatomy.

Keywords: Medical undergraduate, Problem-based question, Traditional clinical question, Assessment.

Introduction

The art and science behind teaching and learning in medical education are changing and progressing remarkably. In recent years, learning in Para-clinical and clinical sciences went through a rapid change.¹ Moreover, teaching and learning have become more advanced and accurate in the

current situation. Students' learning is greatly affected by the assessment method. So, for better outcomes for the students, a good assessment tool should be applied in the curriculum. Assessment has a powerful positive driving outcome on the learning of undergraduates and in the curriculum.²

1. Dr. Farhana Yasmin, Assistant Professor, Department of Anatomy, Gazi Medical College, Khulna, Bangladesh.

Email: farhanadipa.khl@gmail.com

2. Dr. Nahid Farhana Amin, Associate Professor, Department of Anatomy, BSMMU, Dhaka, Bangladesh.

Email: nahidazmin@gmail.com

Anatomy is one of the core subjects in the undergraduate medical curriculum, in which students can learn about the human body structure as well as its functional and clinical correlations. So, as a good assessment tool, Problem-based questions can generate interest in learning and enhance problem-solving skills and analytical skills in undergraduates. Some studies suggested that, as a basic science, Anatomy would be better known, recalled and finally practiced if studied in a clinically applicable way.³ Therefore, problem-based learning as well as problem-based questions as an assessment tool in the written examination would develop more competence for the undergraduates, moreover, they could apply those skills while they attend clinical problems, that do not correspond to their textbook.³

The curriculum for undergraduate Medical Education in Bangladesh has implemented both SAQ and MCQs as written assessment tools, the curriculum has recommended 10% application-level (problem-based) questions in SAQs while constructing written questions.⁴ But recent studies have revealed that problem-based questions couldn't incorporate into the First Professional Written Examination. Therefore, curriculum planners should emphasize more attention during written question construction to incorporate problem-based questions. Moreover, Thompson et al. suggested that offering problem scenarios in sequence with dissections can enhance students' learning experiences making them feel more prepared and confident in their abilities to dissect.⁵ So, incorporating problem scenarios may change students' approach towards their learning in respective subjects and would be reflected in a change in their learning styles.⁶

Problem-based questions as a written assessment tool

In problem-based questions, clinical scenarios are used in the question paper, where students have to understand the scenarios to define their knowledge and the learning would be effective if high-quality scenarios are used.⁷ Furthermore, a case scenario in the question paper should be

clear so that the students can identify the necessary information from the case scenario and after that, utilize their learning to a particular situation, rather than only recalling a fact.⁸ Stake et al. stated that problem scenarios that are used in problem-based learning are either close-ended, in which correct answers can be identified from the scenario, or open-ended, in which multiple solution approaches are possible, yet closed-ended problem scenarios used in medical schools to teach students how they diagnose a patient having a specific disease.⁶ Problem-based questions can be used as an effective assessment tool when problem scenarios are relevant to the stage of the curriculum and within the level of understanding of the students' and scenarios should have acceptable deep-seated interest for the students for future practice.⁷ The undergraduate Anatomy curriculum (MBBS curriculum 2012) of Bangladesh has allotted 10% questions for application-level in which students have to apply their knowledge in a new situation and that may be best applicable by introducing problem-based questions in the undergraduates' written assessment.

Traditional clinical questions as a written assessment tool

Undergraduates' clinical knowledge could be assessed by the traditional clinical questions that are constructed from the clinical topics. Khatun analyzed the First Professional Regional Anatomy portion of Anatomy written question papers (SAQ) from 2012 to 2016, of four public universities in Bangladesh and she found the mean percentage frequency of traditional clinical questions was 10.84%.⁹ It may be said that in Bangladesh traditional clinical questions are commonly addressed in the Anatomy written examination but the proportion of clinical questions could not correspond with the weightage of the Regional Anatomy textbook.

For better outcomes for the students, a good assessment tool should be applied. Educationists believe that, whenever we started to change the assessment method, it could fabricate the students' pursuit of study.¹⁰ So, the incorporation of problem-based questions with traditional clinical

questions in the First Professional Written Examination in Regional Anatomy could increase the brainstorming ability of the undergraduates, moreover they could explore their knowledge of Anatomy in the clinical field.

Changing assessment patterns, students could engage with their study more wisely and their concentration can be shifted to clinical rather than theoretical subjects.¹⁰ The teaching-learning approach, curricular structure, assessment procedure and target of medical education have changed internationally. Moreover, medical education has moved from traditional lecture-based learning to a problem-based learning method. Therefore, analyses of the performance of the medical undergraduates regarding problem-based questions along with traditional clinical questions could assess their problem-solving skills as well as clinical knowledge, moreover, this research would help the teachers and curriculum planners to improve their teaching method and they might have necessary changes in the curriculum. Keeping in mind the context and rationale of the research that has already been mentioned, the following research objective was formulated for the research:

To assess the ability of the medical undergraduates of Bangladesh to answer problem-based objective written questions as compared to their ability to answer traditional clinical objective written questions on Regional Anatomy constructed by the researcher.

Materials and methods

The research was analytically carried out in the Department of Anatomy, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka.

Operational definitions:

Problem-based objective written question

For the present research, this term was used to denote a question that was constructed by creating a clinical scenario based on the information or concept found in the 'Clinical Notes' of a chapter of

the Regional Anatomy textbook (Wineski ed. 2018).¹¹ Therefore, 'true-false' and 'fill-in-the-blanks' types of objective written questions were constructed from this scenario.

Traditional clinical objective written question

In the present research, this term was used to denote a question that was constructed as a 'true-false' or 'fill-in-the-blanks' type of objective written question based on the information or concept from the same 'Clinical Notes' that was used for constructing a corresponding 'problem-based' question.

Methods used to construct problem-based objective questions

One hundred (100) problem-based objective written Regional Anatomy questions were constructed for the medical undergraduates. The textbook of the South Asian Edition of Snell's Clinical Anatomy by Regions was grouped into five compartments.¹¹ Chapters of this book were allocated into five compartments. The number of questions to be constructed from each compartment of the textbook was determined based on the proportion of marks distribution in the different groups of two question papers of the First Professional MBBS Examinations (SAQ portion). There were equal marks in each group, so an equal number of questions were constructed from each compartment. In this research, 100 problem-based Regional Anatomy questions were constructed from five compartments. So, twenty (20) questions were constructed from each compartment.

The clinical texts contained within the subheadings of 'Clinical Notes' excluding the developmental anomalies, microscopic Anatomy, radiological Anatomy and surface Anatomy were used to construct the problem-based questions. As mentioned before that, 20 questions were constructed from each compartment so, 20 subheadings were selected from each compartment of the 'Clinical Notes' by lottery. Repetition was prevented

carefully by discarding the repeated topics. The clinical texts contained within selected subheadings were used to construct one problem-based question. In this way, 100 problem-based objective written Regional Anatomy questions were constructed (20 questions from each compartment). During the lottery, each chapter from each compartment was included.

Methods used to construct traditional clinical objective questions

Hundred (100) traditional clinical objective written Regional Anatomy questions were constructed for the medical undergraduates. Here also 20 objective written questions were constructed from each compartment as like problem-based objective written questions. The traditional clinical questions were constructed from the corresponding subheadings of the 'Clinical Notes' that were selected for constructing the problem-based questions by lottery. In this way, 100 traditional clinical objective written Regional Anatomy questions

were constructed (20 questions from each compartment).

Determining the number of problem-based and traditional clinical objective written Regional Anatomy questions to be constructed from each compartment based on the proportion of marks distribution in the different groups of two question papers of the First Professional MBBS Examinations (SAQ portion). Selecting the subheadings from the 'Clinical Notes' by lottery for constructing problem-based objective written questions and from the corresponding subheadings constructing the traditional clinical objective written questions (during lottery each chapter from each compartment was included). Two types of questions were constructed for the test. They are a) True/False type and b) Fill-in-the-blank type. Problem-based and traditional clinical questions both are two types. From 100 questions 50 were True/False type and 50 were Fill-in-the-blanks type.

Table 01: Examples of problem-based questions (T/F) and (fill in the gaps)

	Read the following case histories and mention "T" on the right of the statement if it is true and "F" if it is false	Put T/F
1.	<p>Case history: A 30-year-old man came to the hospital with a history of stab wound in the root of the neck. On examination, the injury was visible about 2.5 cm above the clavicle.</p> <p>Statement: The apex of the lung is more prone to be injured in this case.</p>	
	Please read the following case histories and fill in the gaps with appropriate word(s).	
2.	<p>Case history: A 5-month-old baby was admitted in the hospital with diarrhoea and vomiting. On examination, there was sunken eyes and anterior fontanelle of the scalp was depressed below the surface.</p> <p>Statement: In this case, depressed anterior fontanelle indicates state of dehydration which is formed by frontal and two _____ bones.</p>	

Table 02: Examples of traditional clinical questions (T/F) and (fill in the gaps)

Put T/ F		Please read the following statements and mention “T” on the left of the statement if it is true and “F” if it is false
	1.	The apex of the lung is vulnerable to stab wounds in the root of the neck.
		Please read the following statements and fill in the gaps with appropriate words (Each gap represents one word)
	2.	Bulging of the anterior fontanelle which is formed by parietal and _____ bones indicates raised intracranial pressure.

Participants and conduction of the research

The medical undergraduates of both government and non-government medical colleges who recently appeared in the First Professional MBBS Examination of Anatomy were considered participants in this research. One government and one non-government medical college in Bangladesh were selected through convenience sampling. After taking written permission from the respective authorities of each medical college for the test, detailed instruction was given regarding the conduction of the test using a PowerPoint presentation, a lecture class was selected, and a large number of students were present in the lecture class. The undergraduates were selected by randomization. A total of 166 undergraduates participated in the test from two medical colleges. Half of the undergraduates (83) were selected as ‘problem-based’ group and the other half of the undergraduates (83) were selected as ‘traditional clinical’ group. The ‘problem-based’ group answered 100 problem-based questions and the ‘traditional clinical’ group answered 100 traditional clinical questions. A written informed consent was taken from each medical undergraduate. The time duration was one hour to answer 100 objective written questions for both groups.

Analyses of medical undergraduates’ performances regarding the ability to answer problem-based and traditional clinical objective questions

There were different types of symbols used to

indicate different types of responses from the undergraduates (like ‘correct’, ‘incorrect’ and ‘unattempted’ responses). The data were entered into the software Statistical Package for Social Sciences (SPSS) Version 24. The data of the ‘problem-based’ group and ‘traditional clinical’ group were compared to look for any significant differences between the frequencies of correct, incorrect and unattempted responses using the Mann-Whitney U test. The differences were expressed in terms of p values taking $p \leq 0.05$ as significant and at 95% confidence intervals.

Results

Performances (for correct, incorrect and unattempted responses) of the undergraduates of the ‘problem-based’ group and ‘traditional clinical’ group were analyzed. At first, the normality of data from both groups was determined by ‘Shapiro-Wilk’ test. The result of the test indicates that the data of correct responses from ‘problem-based’ group and ‘traditional clinical’ group were normally distributed where $p = 0.51$ and $p = 0.17$ respectively. The data of incorrect responses from the ‘problem-based’ group were normally distributed with $p = 0.61$, but in the case of ‘traditional clinical’ group, data were non-normally distributed with $p = 0.00$. Moreover, the data of unattempted responses from ‘problem-based’ group and ‘traditional clinical’ group were non-normally distributed with $p = 0.00$ and $p = 0.00$ respectively.

For the comparison of the performances, the values of the correct, incorrect, and unattempted responses of the two groups were expressed as means and medians (as there were non-normal distributions also determined). The hypothesis testing was done for the differences between the two groups (regarding performances) for the outcome variables using the Mann-Whitney U test (for both normal and non-normally distributed data). It was done because medians are the choices if there are non-normally distributed data.

The results of the hypothesis testing suggested that the two groups differed significantly regarding correct and unattempted responses ($p = 0.00$). Thus, the performance of the 'problem-based' group answering problem-based questions was significantly poorer than 'traditional clinical' group answering traditional clinical questions. But the two groups did not differ significantly regarding the incorrect responses ($p = 0.57$) as shown in Table 03. A

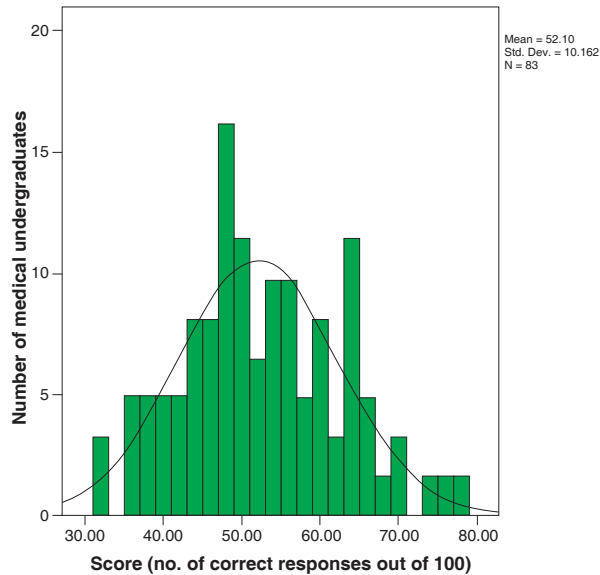
lower mean and median frequencies of correct responses are shown in the 'problem-based' group as compared to the higher mean and median frequencies of correct responses in the case of the 'traditional clinical' group. Moreover, a higher mean and median frequency of incorrect and unattempted responses in the 'problem-based' group compared to 'traditional clinical' group.

The frequency of correct responses from an individual undergraduate was considered as the 'score' of that undergraduate. The frequency distributions of 'score' in the two groups are shown in Figure 01 and they seemed different. From the skewness and the histograms it can be understood that the 'scores' in the 'problem-based' group were normally distributed, but slightly skewed to the right, on the other hand, the 'scores' in the 'traditional clinical' group were also normally distributed but slightly skewed to the left. Thus, histograms indicate relatively lower scoring of the 'problem-based' group than 'traditional clinical' group.

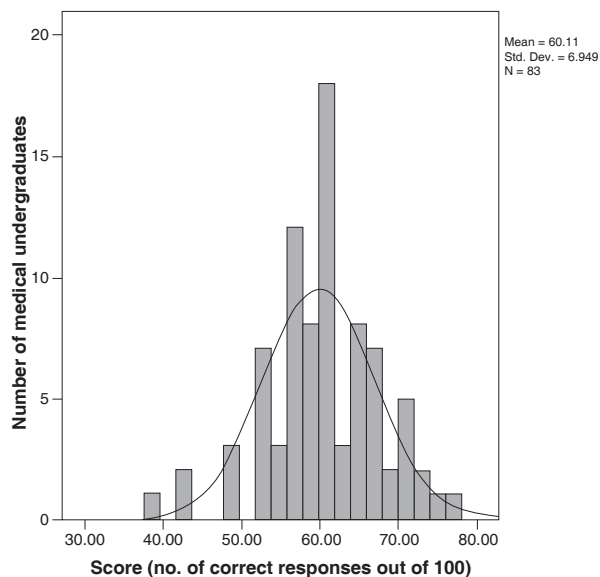
Table 03: Comparison of performances between the 'problem-based' group and 'traditional clinical' group

Type of response	Performance (i.e., frequency of responses)		Significance (p-value)	95% Confidence interval of the difference
	'problem-based' group	Traditional Clinical Group		
	Mean \pm SD Median (25 th and 75 th percentile)	Mean \pm SD Median (25 th and 75 th percentile)		
Correct	52.09 \pm 10.16 51.00 (45.00, 60.00)	60.10 \pm 6.94 60.00 (57.00, 64.00)	0.00 S	- 5.34 to - 10.68
Incorrect	33.91 \pm 9.14 33.00 (27.00, 40.00)	33.22 \pm 7.79 33.00 (29.00, 36.00)	0.57 NS	3.29 to - 1.91
Unattempted	14.34 \pm 11.15 12.00 (4.00, 23.00)	7.62 \pm 5.32 7.00 (3.00, 10.00)	0.00 S	9.40 to 4.04

S, Significant; NS, Non-significant
 n = 83 for each group of medical undergraduates
 $p \leq 0.05$, was considered significant in the Mann-Whitney U test



(A) 'Problem-based' group



(B) 'Traditional clinical' group

Figure 01: Comparison of frequency distributions of 'scores' (no. of correct responses) between the 'Problem-based' group' (figure A) and 'Traditional clinical' group' (figure B)

Discussion

This research was carried out to incorporate newer teaching learning and assessment methods in Anatomy. In this view, we assessed the performances of the undergraduates in response to problem-based questions compared to traditional clinical questions. Therefore, undergraduates were assessed by their retrieved relevant knowledge from long-term memory rather than their understanding, concepts and problem-solving skills.

In the present research performance of the 'problem-based' group was significantly poorer than the 'traditional clinical' group. It was also observed that there were a significantly higher number of 'unattempted' responses in the case of 'problem-based' group in answering problem-based questions than the 'traditional clinical' group in answering traditional clinical questions, that indicates problem-based group could not understand how the knowledge of Anatomy could be applied to answer the problem-based questions.

In a similar study, author found that the performance of the 'Clinical Group' answering clinically-oriented questions was poorer than the performance of the 'Non-clinical Group' answering non-clinically-oriented questions in Regional Anatomy, though the difference was not statistically significant.⁹ Furthermore, another study showed that the performance of the 'Clinical Group' answering clinically-oriented questions was significantly poorer than the 'Non-clinical Group' answering non-clinically-oriented questions in Embryology.¹² A similar study also revealed that undergraduates of Bangladesh answering clinically-oriented questions were significantly poorer than those answering non-clinically-oriented questions in Neuroanatomy.¹³ Therefore, it may be concluded that in the present research, the undergraduates performed better in answering traditional clinical questions as compared to the previous studies, it might be due to the present research's problem-based questions compared with the traditional clinical questions and Bangladeshi

undergraduates experienced with the clinical questions on clinical topics provided in the chapters of the textbook, other than the problem-based questions or problem scenarios.

Khatun, Sumya and Akter analyzed First Professional Anatomy written question papers from different years of four public universities in Bangladesh and they found only clinical questions were addressed in the question papers whereas they didn't find problem-based questions in every subdivision of Anatomy like Regional Anatomy, Embryology and Neuroanatomy respectively^{9,12,13}. Therefore, it could be stated that Bangladeshi undergraduates have never experienced problem-based questions in their professional examination though the percentage of marks allocated in the undergraduate medical curriculum (2012) for application-level of questions is 10%, the curriculum-directed format was not followed properly in the Professional Examination. Moreover, undergraduates' learning methods are lecture-based other than problem-based in Bangladesh, so they could not apply their knowledge to problem-solving questions and their performances were poor.

In the present research, undergraduates appeared on the test without any clinical exposure or problem-solving learning skill. Whereas, Kar et al. believed that, early clinical exposure with integrated knowledge of basic sciences of undergraduates can be helpful not only for better knowledge moreover, it could motivate them for learning and elevate their level of self-confidence.¹⁴ Kar et al. compared the performances of the First Professional MBBS students in Neuroanatomy by problem-based questions with early clinical exposure and without early clinical exposure and the study revealed, the performances of the students has been significantly improved after early clinical exposure and also it has increased their interest in Neuroanatomy.¹⁴ Similarly, Punja, Sumalatha and Hosapatna observed that first-year undergraduate medical students felt early clinical exposure was useful when a small group was taken to the hospital to demonstrate relevant cases, they had a more

powerful impact on learning Anatomy.¹⁵ So, it may be concluded that early clinical exposure of undergraduates could integrate the clinical sciences with the subject Anatomy, which would increase their interest in problem-solving activity, moreover, they would become self-directed learners and be motivated for lifelong learning.

In recent years many medical schools have implemented problem-based learning in the undergraduates' MBBS curriculum. During the fall of 1989 in the gross Anatomy course for First year medical and dental students' problem-based learning was implemented at the University of Florida.¹⁶ Prakash et al. assessed the effectiveness of problem-based learning for teaching Neuroanatomy, where First-year MBBS students were assessed by multiple choice questions (MCQ) test before and after the problem-based learning session and the mean scores of the students in the MCQ test were significantly high after the problem-based learning session and most of them preferred problem-based learning along with their regular teaching.¹⁷ Similarly, Yuvaraj and Parveen compared the performance of one group of students who taught cerebellum by problem-based learning method and another group was taught cerebellum by traditional lecture-based method, students' scores in the 'Problem-based Group' was more than the students in 'Lecture-Based Group' in 60% questions and the perception of the students about problem-based learning was appreciated and accepted by the students.¹⁸ Again Gowri, Janaki and Sekhar found a statistically significant difference in the scores obtained by the First year MBBS students in a test in which the problem-based learning method is compared to the traditional lecture-based method, moreover students' feedback was problem-based learning enhanced their understanding of Anatomy and motivated them to read more.¹⁹ In comparison with the present research they all had a problem-based learning session, so they achieved better performances with problem-based sessions, whereas in the present research without a problem-based learning session, they performed poorly in problem-solving questions.

Another study revealed that post-test scores after problem-based learning of First year MBBS students were significantly higher than the pre-test scores where 68% of students felt that the method used in teaching problem-based learning in Anatomy was useful.³ Similarly khaki et al. got similar findings in their study in which First-year medical students were taught gross Anatomy with the traditional teaching method in the first semester then the same topics were taught with the problem-based method in the second semester, after a test following problem-based learning that was significantly higher than the score following traditional teaching method and students felt that they had acquired more knowledge of Anatomy in problem-based learning.²⁰ Moreover, Pawlina et al. got a similar response from the students in their study, in which 82% of the students' feedback was problem-based learning sessions in gross Anatomy was the more understandable method that could provide clinical correlations with gross Anatomy¹⁶, furthermore, the study compared to some other studies in which most of the students agreed with the same statement that problem-based learning is an efficient teaching method which enhances their skill to ask questions and solve problems²¹⁻²³. So, with the comparison of these previous studies in the present research performance of the 'Problem-based' group answering problem-based written questions was significantly poorer than the 'traditional clinical' group answering traditional clinical objective questions, the reason might be the teaching-learning methods had been lecture-based for years in the undergraduate medical curriculum of Bangladesh, moreover, problem-based questions had never been implemented in the Professional Examinations. In another study Potu et al. suggested, learning objectives in Anatomy have not been covered extensively in a problem-based learning curriculum therefore an integrated approach may be beneficial for students where clinical science could be correlated with the basic science.²⁴ Similarly, another study evaluate a PBL curriculum, and they found that embryology, histology, and osteology could not be covered adequately through clinical problems, so they recommended a hybridized

approach for teaching-learning Anatomy in the undergraduate curriculum and the important topics that could not be learned through clinical problems that could be taught through lectures.²⁵ Therefore, we compared the present research with the previous studies and found that the problem-solving skills of the undergraduates were poorer than the traditional clinical topics solving skills.

Conclusion

Results of the present research regarding the performances of the undergraduates are poorer in answering problem-based questions as opposed to traditional clinical questions. So, it may be suggested that if the curriculum planners incorporate the problem-based learning method in Anatomy with the traditional lecture-based method that would have an effective teaching-learning method to improve undergraduates' learning of Anatomy and integration with the clinical subjects. Furthermore, by incorporating problem-based questions along with the traditional clinical questions in written Examinations as well as oral and practical Examinations, higher levels of the cognitive domain could be assessed in the undergraduates. Thus, some modifications are necessary for the teaching-learning and assessment methods to improve undergraduate learning in Regional Anatomy. And the curriculum planners should take the necessary modifications and it should be reflected in the assessment system.

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