

Article

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Analysis of different levels of cognitive domain in undergraduate written short answer questions in Physiology: A descriptive study in Bangladesh

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Abstract

Background: Teaching-learning and assessment of Physiology should be more organized because it builds the foundation for clinical science. A written question sheet on Physiology can be claimed ideal when it can assess the competence at different levels of cognitive domain of student's learning. **Objectives:** The aim of the present study is to find out the prevalence of questions addressing different levels of cognitive domain in the first professional MBBS written examination on Physiology. **Methods:** This descriptive and retrospective type of study was conducted in the Department of Physiology, BSMMU, Dhaka, during the period of March 2020 to February 2021. A total 67 Short Answer Question(SAQ) sheets in the first professional MBBS examinations of the last five years of four public universities of Bangladesh were analyzed following revised Bloom's Taxonomy. The frequency percent of questions addressing six levels of cognitive domain was manually calculated. **Results:** 'Question-segments' assessing remember level were greater than 80%, Whereas, 'question-segments' assessing understand, apply and analyze level ranged between 11-13%, 0.25-0.95% and 0.11-0.67% respectively in all the universities. No 'question-segment' was found addressing evaluate and create level of cognitive domain. **Conclusion:** From the results of this study, it may be suggested that there is almost absence of questions for assessment of student's higher order thinking ability and most of the questions used, assessed the lowest level of cognition process in the first professional MBBS written examination on Physiology under four public universities of Bangladesh. **Key words:** SAQs, levels of cognitive domain, Physiology

Introduction

Physiology is one of the basic subjects of medical science which lays foundation of all branches of medical sciences.¹ The human Physiology explains the mechanisms of various complex control systems of the human body that make it a living being.² The knowledge about human health and physical performance is provided by human Physiology. Proper understanding of Physiological mechanisms can help to provide a deeper perception of the complexity of the human body¹. In this strand, teaching of Physiology is an art that conveys knowledge from teacher to student by teaching-learning process.³

In learning process, assessment is an essential part which acts as a dominant motivator to direct and drive student's learning.⁴ It is the evaluation system that have immense effect on students learning rather than the educational objectives or curriculum or instructional techniques⁵. The learning objectives of the course can be judged by assessment.⁶ The success of the delivery of learning materials can be measured by student's performance through assessment.⁷ Teaching and assessment together create meaningful learning. Assessment provides feedback for both teacher and student. For teacher, the level of efficacy of the teaching program can be measured. It enables the student to realize what they learned and more importantly what they did not learn because awareness of ignorance is important for learning.⁸ The method of assessment influences the students' choice of learning approach. For this reason, the quality of the assessment should be up to the mark, not just to test the recall of the isolated facts, otherwise it would promote the superficial learning approach.⁹

In the learning process, Bloom's Taxonomy is a classification of human cognition. The 'Taxonomy of Educational Objectives: The Classification of Educational Goals' was published in 1956 called Bloom's Taxonomy, after Benjamin Bloom, an educational psychologist

who was one of the authors of this volume.¹⁰⁻¹¹ To achieve the educational goal, it acts as a framework.¹¹⁻¹² The six major categories in the cognitive domain defined by the original Taxonomy were- Knowledge, Comprehension, Application, Analysis, Synthesis and Evaluation. In the revised Taxonomy, the six major categories were changed into- Remember, Understand, Apply, Analyze, Evaluate and Create.¹³ To emphasize the development of learning outcome in the educational program, an ideal question paper should include each of the categories.¹⁴ In recent days, the assessment design mainly focuses on the lowest level of the Taxonomy.¹²

To test students' higher order cognitive skill as well as ability to recall facts, written examination is a very effective assessment tool.¹⁵⁻¹⁶ Both SAQ and Multiple Choice Questions (MCQ) has been employed as written assessment instruments according to Curriculum for undergraduate Medical Education in Bangladesh.¹⁶ SAQ is a major component of written assessment technique that commonly used in the professional examination of MBBS course in Bangladesh⁷. It is reliable, valid method for judging student's merit for their cognitive power. It can assess large number of students at a time. It can assess the ability of the student to organize and write logically, systematically and with judgement. The acquisition capacity of information and facts can also be assessed by it.¹⁷ A wide range of topics can be tested in a short time period⁵. The present form of 'Curriculum for Undergraduate Medical Education' in Bangladesh has its first inception in 1988, then it was revised in 2002 and 2012¹⁸. During moderation of SAQ for first professional MBBS examination, 60% questions for recall, 30% for understanding and 10% for application type of questions has been recommended by the curriculum, 2012.¹⁶ But till date, no study investigated the implementation of curriculum

recommended proportion of questions exploring the cognitive domain level in written assessment of Physiology in medical undergraduate program in Bangladesh. Therefore, this study aimed to find out the proportion of cognitive domain level specific pattern of question used in the past five year's written assessment on Physiology among medical undergraduates held under different universities in Bangladesh. It also intended to observe the trend of domain level specific question used by different public universities in Bangladesh and adherence to curriculum recommended proportion of bloom taxonomy domain specific question in practice of question setting in undergraduate Physiology assessment..

Methods

This descriptive and retrospective type of study was carried out in the department of Physiology, Bangabandhu Sheikh Mujib Medical University, Dhaka. In this study, total 67 SAQ sheets of paper I and paper II, used in the first professional MBBS written examinations on Physiology under four public universities of Bangladesh including University of Dhaka (DU), University of Rajshahi (RU), University of Chittagong (CU) and Shahjalal University of science and Technology, Sylhet (SU) held in last five years (2015-2019) according to 'Curriculum for Undergraduate Medical Education in Bangladesh-Updated 2012' were collected for analysis. Usually, two first professional MBBS examinations are held in May and November as per new curriculum. The SAQs were analyzed according to six levels of cognitive domain of revised Bloom's Taxonomy (Krathwohl 2002). After collecting the SAQ sheets, the 'questions' of each SAQ sheet and 'question-parts' and 'question-segments' of each 'question' were identified. The levels of cognitive domain addressed by each 'question-segment' was then

identified following the revised Bloom's Taxonomy considering the action verb used in the 'question-segment'. Then the frequency percentage of each type of 'question-segments' addressing different levels of cognitive domain was calculated separately in each individual university as well as based on year of examination at each university. Data was expressed as number and percentage.

Results

Twenty written SAQ sheets of DU, 20 sheets of RU, 10 sheets of CU and 17 sheets of SU were analyzed. There were 16 questions in each SAQ sheet. Thus, a total of 1,072 questions were found. Each question had one or more 'question-parts' and a total of 2,392 'question-parts' were found. Again, each 'question-part' had one or more 'question-segments'. Therefore, a total of 3,061 'question-segments' among 67 questions were identified and analyzed. Percentage of 'Question-segments' addressing remember level, understand level, apply level and analyze level used in the first professional MBBS examinations held under DU, RU, CU and SU are shown in the table I. None of 'question-segments' of universities were reached at evaluate level except SU and that was 0.11%. No 'question-segments' were found to achieve create level of cognitive domain among the four public universities of Bangladesh (table I). Among the cognitive domain level specific, recall level question segments were at the top followed by understanding and apply level in order. Very few question segments found at analyze and evaluate level and these pattern were almost similar among all four universities.

In this study, the results also showed decreased trend of 'question-segments' focusing remember level and increased trend of 'question-segments' focusing understand level, but there was no definite pattern for apply level and analyze level 'question-segments' found with progression of

years at University of Dhaka (Figure 1). On the other hand, no definite pattern was found for any level of cognitive domain at rest of the three universities (Figure 2,3,4).

Figure 5 has shown the comparison between the recommendation of proportion of level specific question and actual implementation during the past 5 years.

Table I: Frequencies of different levels of cognitive domain addressed in the ‘question-segments’ in the first professional MBBS examination from 2015 to 2019 in the four public universities of Bangladesh

Level of cognitive domain	DU (n=839) No. (%)	RU (n=940) No. (%)	CU (n=393) No. (%)	SU (n=889) No. (%)
Remember	697 (83.06)	800 (85.11)	320 (81.42)	728 (81.89)
Understand	98 (11.68)	127 (13.51)	53 (13.49)	121 (13.61)
Apply	8 (0.95)	4 (0.43)	1 (0.25)	5 (0.56)
Analyze	1 (0.12)	1 (0.11)	1 (0.25)	6 (0.67)
Evaluate	0 (0.00)	0 (0.00)	0 (0.00)	1 (0.11)
Create	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)

n-total number of ‘question-segments’ in all the available SAQ sheets of each university; DU-University of Dhaka; RU-University of Rajshahi; CU-University of Chittagong; SU- Shahjalal University of Science and Technology, Sylhet

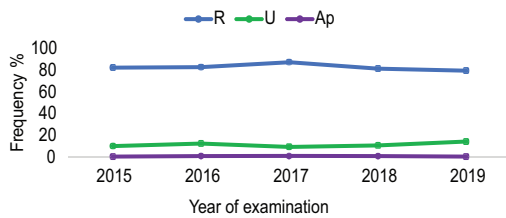


Figure 1: Trend of ‘question-segments’ addressing different levels of cognitive domain over consecutive years of examination at University of Dhaka. R –remember level; U –understand level; Ap –apply level

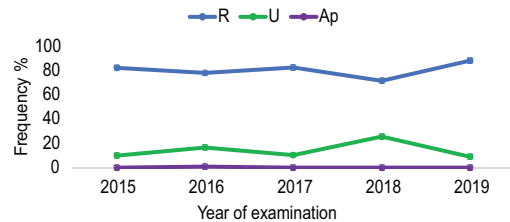


Figure 3: Trend of ‘question-segments’ addressing different levels of cognitive domain over consecutive years of examination at University of Chittagong. R –remember level; U –understand level; Ap –apply level

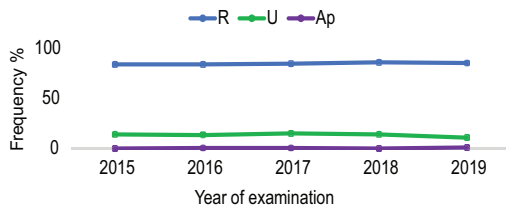


Figure 2: Trend of ‘question-segments’ addressing different levels of cognitive domain over consecutive years of examination years at University of Rajshahi. R –remember level; U –understand level; Ap –apply level

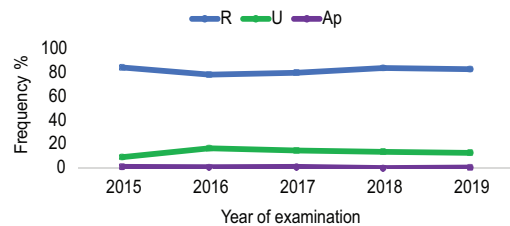


Figure 4: Trends of ‘question-segments’ addressing different levels of cognitive domain over consecutive years of examination at Shahjalal University of Science and Technology, Sylhet. R –rememberlevel; U –understandlevel; Ap –applylevel

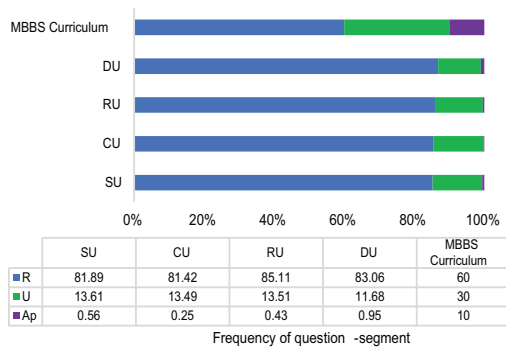


Figure 5: Comparison of curriculum recommended frequency of ‘question-segments’ of SAQs on Physiology for different levels of cognitive domain in the first professional MBBS examination with that of four public universities of Bangladesh

Discussion

For developing assessment tools, the Bloom’s Taxonomy is a benchmark.¹⁹ To appreciate the prerequisite skills for learning, understanding of this hierarchy is mandatory for both teachers and students.²⁰ Therefore, the assessment method should also include items for assessing higher order of thinking in addition to lower order of thinking.¹⁶

In the present study, analyses of SAQ sheets on Physiology in both Paper-I and Paper-II under new curriculum of four public universities of Bangladesh identified the proportion of ‘question-segments’ attempted to test different cognitive levels to assess the student’s range of competence.

This SAQ analysis demonstrated that, ‘question-segments’ assessing lowest level (remember level) contributed greater than 80% of the total SAQs among all the four public universities. Whereas, ‘question-segments’ assessing understand level ranged from 11-13% and 0.25-0.95% ‘question-segments’ represented apply level. Moreover, only 0.11-0.67% ‘question-segments’ focused on analyze level and no ‘question-segment’ was found addressing evaluate level and create level of cognitive

domain. Distribution of SAQs addressing all these different levels were almost similar among all universities. Therefore, ‘question-segments’ addressing remember level carried most of the weightage than the other higher levels of cognitive domain. The outcome of this analysis suggests that the current assessment tool (SAQ) used in the written assessment can assess only the lowest level of cognitive skill of the students. So, it can be claimed that, the current practice of SAQ type cannot test the student’s ability for higher order thinking skill in Physiology in our country. As there was no remarkable variation in this trend among the major public universities, it can be generalized for relatively poor assessment technique applied in written assessment of undergraduate medical education of Physiology in Bangladesh.

A similar analysis on SAQs in Physiology showed almost all questions belonged to lower order thinking (recall and understanding) of cognitive domain in the four public universities of Bangladesh.⁵ If we look at the questions addressing different levels of cognitive domain in other disciplines of different universities of Bangladesh, a similar trend can be identified.^{16,21,22} Some previous studies on Biochemistry and Pharmacology in Pakistan reported a higher frequency of questions focusing recall level, a lower frequency of understand level and no question addressing problem solving level of cognitive domain.^{4,9} Findings of the present study is almost similar to the finding of these previous studies in basic medical sciences.

In the current undergraduate curriculum for Physiology updated in 2012, there is no indication about the proportion of questions to be incorporated to test the levels of cognitive domain in written assessment. But the ‘manual for 1st professional examination based on new curriculum 2012’ for undergraduate medical education, recommends 60% for recall level, 30% for understand level and 10% for problem solving/application level for SAQs to set for the

first professional MBBS examinations. Therefore, it was expected that the question moderators would follow this guideline in the undergraduate assessment. But the results of this analysis of SAQs from 2015 to 2019 used in the four public universities of Bangladesh demonstrates poor implementation of above-mentioned guideline. Moreover, the examination guideline also did not provide the option of assessment of higher order thinking.

Conclusion

The results of this study suggested that there was almost absence of questions for assessment of student's higher order thinking ability and most of the questions used in the first professional MBBS written examination on Physiology under four public universities of Bangladesh, assessed the lowest level of cognition process in the last five years. In addition, guidelines on proportion of level specific to be used in Physiology assessment was not followed while question setting in the undergraduate Physiology examination under any university. So, question exploring higher order thinking ability in Physiology should be introduced in curriculum recommendation in addition to reducing the proportion of question addressing lowest order of thinking.

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