Original Article

Assessment of Undergraduate Medical Students in the Department of Physiology using Multiple Choice Question and Short Answer Question

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Abstract:

Background: Assessment is a powerful educational tool with precise framework of medical education by formulating good quality of Multiple Choice Questions (MCQ) and Short Answer Question (SAQ). Difficulty Index (DIF-I) and Discrimination Index (DI) are used to determine the essence of the MCQ and SAQ of written assessment method. Objective: To evaluate the assessment levels of medical students with correlation between MCQ and SAQ used in Physiology examination. Methods: This cross sectional study was conducted on 150 First year MBBS students of Enam Medical College, Savar, Dhaka, who appeared in 1st, 2nd and 3rdterm final internal examination of Physiology from January 2019 to February 2020.Difficulty Index (DIF- I) and Discrimination Index (DI) of a total 60 MCQand 54 SAQ were analyzed. Results:After data analysisamong internal examination, maximum 70% MCQmarks of DIF-I within the appropriate level and 5% items were difficult. Whereas DI of majority MCQ marks 65% was excellent and 5% ofthe items were poor. Again, data analysis on SAQfound 68.01% recall and 36.67% understanding types but poor percentage of problem based types of questions. DI of SAQ found 24% excellent and 1.9% was poor.There was significantly positive correlation of MCQ with SAQ.Data were statistically analyzed by Independent sample 't' test and Pearson's correlation coefficients test using SPSS version 26. Conclusion: In this study, observed that there is no single best method for assessing cognitive levels of medical students. So. two important written format (MCQ & SAQ) must be interrelated for better outcomes.

Key words: Discrimination Index,MCQ, SAQ

Introduction

Medical education has significantly changed with high quality assurance over the past few decades.[1] The most important feature of an updated academic curriculum is assessment through written, practical and oral.[2,3] Learning tool helps to measure the progress of training for success of goal.[4]

Assessment cycle related with interpretation of examination scores withquestion creation.[5,6] From 2012 revised curriculum, in Bangladesh under the Dhaka University, MBBS (Bachelor of Medicine and Bachelor of Surgery) course includes Phase-I, II, III & IV. Phase-I subjects for

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undergraduate medical students includes Physiology, Anatomy and Biochemistry. In Physiology subject, medical students are assessed by summative and formative.[1-3] Again formative assessments that include item examination, card final and term final those are shape of development for the quality of education.[4]

For assessments, practical or written examinations can assess the student's cognition, skill performance and attitude. For the undergraduate students, cognition can be assessed in two different written formats: selected response format (SRF) and free response format (FRF) besidesskill performance and attitude are assessed in the practical (clinical) examination. SRF includes multiple choice questions (MCQs) and extended matching questions. FRF includes short answer questions (SAQs), short essay questions (SEQs), Modified essay question (MEQ), problem based question (PBQ) and long answer questions.[5-9]

Most common written assessment methods include multiple choice questions (MCQs) and short answer questions (SAQs). There are some group of researcher, who gives more emphasis on MCQ,[3,5] other researchers also found SAQ is more reliable and superior.[12,14] So, it is important to assess the correlation between the two different formats (MCQ & SAQ) of written assessments.[10]

Medical education has been found to play a vital role in nation building by the review and formulation of curriculum component is an ongoing process in several medicalcolleges all over the world.[22]In Bangladesh, medical education is centrally controlled by the Government (govt.) and run a unique undergraduate curriculum throughout the country in both govt. and non govt. sectors.[2,4]Learning process must be assessed in multiple modes and contexts. Written examination is traditionally and widely accepted an integral part of the evaluation of the undergraduate medical science.[15,17]

MCQ become more objective and easily scored both manually and electronically and also assess the problem solving skill ability.[10] MCQ have the disadvantage that higher chances of student guessing that lead to falsely higher scores than other written methods.[3,21]MCQ is one of the tool that consists of stem and 5 true or false responses. True or correct answer to a question is called key and false or incorrect answer is called distracters.[21]It depends mainly sufficient and appropriate balance between key and distracters. Students select the correct answers by circling the associated number or letter, or filling in the associated circle on the machine-readable response sheet.[20]

Another written assessment method, SAQ scoring is subjective and more time consuming than MCQ. SAQ are prone to error and risks of bias.[14,15] Also, most of the studentshandwritten responses are not clear and unreadable.[11]Although, this format of assessment reflects student's interpretive skills and provides flexibility in their responses.[16]

Furthermore, it does not suitable to assess problem solving skills.[13,18]

According to curriculum of 2002 and revised from 2012, Physiology SAQ (Paper- I and Paper- II) of First Professional MBBS examination held twice (regular and supplementary) in a year under the Dhaka University. In each paper there are Group -A and Group -B, each group contains 35 marks. Each question having 05 marks where students answer any 07 questions from each group out of 08 questions.[1,2]Scores of internal examinations (1st, 2nd and 3rd term final) by written assessment format (MCQ and SAQ) of Physiology department that helps to make 10% mark for formative assessment.

Several studies have established to explore a strong correlation between MCQ and SAQ to determine the adequacy of knowledge with standardization.[10] This results can be applied to the practical improvement of assessment practices.[12] By Difficulty Index (DIF-I) and Discrimination Index (DI) of written format is a way of good assessment communication between students and teachers.[14]

Choosing the best method for assessment in terms of reliability and validity remains a matter of debate. So, now-a-days integration of teaching method ismost popular method worldwide. It means bridging connections between academic knowledge and practical.[19]

Currently, no single assessment method is perfect and no single test can competence for the performance of a medical knowledge. For a reliable and valid assessment, multiple methods should be employed.

Materials and Methods

This cross sectional study was carried out in the Physiology department, Enam Medical College, Savar, Dhaka. The data were collected from the 1st, 2nd and 3rdterm final Physiology written (MCQ and SAQ)internal examinations over a 1year period. A total 150 1st year bothBengalis

and Foreigners Phase-I MBBS students were appeared.

In each term final examination, MCQ paper includes 20 multiple true or false options. Each MCQ have a single stem with 5 responses or options. Total 20 mark was allotted for 20 MCQs. 0.2 marks was allocated for each correct answer and zero (0) marks for each incorrect answer so, score range was 0-1.Total 60 MCQs of all term final examinationswere analyzed. There was no negative marking and the passed marks were 12 (60%).

A total 54 SAQ papers of all term final examinations were included while in each paper includes Group- A (40 marks) and Group- B (40 marks). In each group there were 09 questions with or without multiple segments to assess cognitive levels of medical students. Each question carried 05 marks and students answered any 08 questions from each group and the passed marks were 48 (60%). According to curriculum, every segment of the questions in a paper was categorized as 60% recall, 30% understanding and 10% problem based learning (PBL)types.[22,23]

The appeared students were considered as high achievers (H) and low achievers (L) group. Discrimination index of MCQ and SAQ and difficulty index for each MCQ item were analyzed. For statistical analysis, Independent sample 't' test and Pearson's correlation coefficient test was performed by using SPSS version -26 & $p \leq 0.05$ was accepted as level of significance.

Difficulty Index (DIF-I):

It is the percentage of students in high and low achievers group who answered the item correctly and ranges between 0% and 100%, where the percentage refers to the percentage of students from the total of the lower and upper groups.[5,7]The following formula was used to calculate the DIF-I = H + L × 100/N.

Discrimination Index (DI):

DI is the ability or degree of an item to differentiate ordiscriminates between students of high and low achievement and ranges between 0 and 1.Index of 0.40 and above is regarded as very good items, 0.30 to 0.39 is reasonably good, 0.20 to 0.29 needs improvement and 0.19 or below is to be revised .[5,7]It was calculated by using the formula: DI = 2 × (H–L)/N.

Here, H = number of students answering the item correctly in the high achieving group, L = number of students answering the item correctly in the low achieving group, N = total number of students in the two groups.

Result

Total 60 MCQs were analyzed where each question contains highest value one (1) and lowest value zero (0). After statistical analysis, Mean score of 1st, 2nd and 3rd term was 16.39±1.75, 16.30±2.21 and 16.73±1.62 respectively. Difficulty Index (DIF-I) of maximum 12(60%) items were in the acceptable range (30-70%), only 2 (10%) item was difficult in 1st term final, DIF-I of maximum 14(70%) items were in the acceptable range (30-70%), only 1 (5%) item was difficult in 2nd term final and DIF-I of maximum 10 (50%) items were in the acceptable range (30-70%), only 3 (15%) item was difficult in 3rd term final internal examination. Interpretation of the results of DIF of MCQ was shown in Table-I.

Table I: Difficulty Index (DIF-I) ofMCQs of Physiology internal examination (n=60)

Internal examination	Number (% of frequency of MCQ			
	Easy	Medium	Difficult	Mean ± SD
1st term final (20 MCQ)	6 (30%)	12 (60%)	2(10%)	16.39 ± 1.75
2nd term final (20 MCQ)	5 (25%)	14 (70%)	1 (5%)	16.30± 2.21
3rd term final (20 MCQ)	7 (35%)	10 (50%)	3 (15%)	16.73± 1.62
Cut off point (%)	>70	30-70	<30	51.64±18.71

Discrimination Index (DI) of majority of the MCQ items found, 13 (65%) of 3rd term final was excellent (≥0.35), 9 (45%) of 2nd term final was average (0.20-0.34) and 1 (5%) of 1st term final was poor (<0.20)shown in table-II.

Table II: Discrimination Index (DI) of MCQs of Physiology internal examination (n=60)

Interpre-tation	Internal Examination number (%Frequency of MCQ)			Cutoff point (%)
	1st term (20)	2nd term (20)	3rd term (20)	
Excellent	11 (55%)	9(45%)	13 (65%)	≥0.35
Average/ Good	8(40%)	9 (45%)	5(25%)	0.20-0.34
Poor	1(5%)	2 (10%)	2(10%)	<0.20

A total of 54 SAQ papers of Physiology internal examinations were included for analysis. Table-III shows that the mean percentage of scores of SAQ, 65.48%, 33.05% and 1.46% were allocated for recall, understanding and problem based type of questions respectively. The percentage of marks allocated for recall was significantly highest in 3rd term (68.01%) and lowest in 1st term (63.33%) examination. The percentage of marks allocated for understanding was significantly highest in 1st term (36.67%) and lowest in 3rd term(30.01%) examination. No mark was allocated for problem based type of SAQ in 1st term final. Therefore, significantly highest scores of SAQ 2.41% in 2nd term and 1.98% in 3rd term was allocated for problem based questions.

Table III: Mean percentage of scores of SAQ of undergraduate Physiology internal examination (n=54)

Internal examination	Scores distribution of types of SAQs		
	Recall (%)	Understanding (%)	Problem based (%)
1st term final	63.33	63.33	63.33
2nd term final	65.11	32.48	2.41
3rd term final	68.01	30.01	1.98
Mean	65.48	33.05	1.46

Frequency distribution of SAQ majority found, 13 (24%) 3rd term final was excellent, 6(11.1%) 1stterm final was average and1 (1.9%) of 2nd and 3rdterm final was poor respectivelyshown in table-IV

Table IV: Frequency distribution of SAQ of under-graduate Physiology internal examination (n=54)

Interpretation	Number (% frequency of the SAQ)		
	1st term final 18(33.33%)	2nd term final 18(33.33%)	3rd term final 18(33.33%)
Excellent	10 (18.5%)	12(22.2%)	13(24%)
Average/Good	6 (11.1%)	5(9.2%)	4(7.4%)
Poor	2 (3.7%)	1(1.9%)	1(1.9%)

Internal assessment marks showed a positive correlation with MCQ and SAQ written assessment method which was highly significant that are found in Table -V.

Table V: Correlation of MCQ with SAQ of Physiology internal examination

Internal examination	Correlation of MCQ and SAQ	
	r value	p value
1st term final	0.712	<0.001***
2nd term final	0.341	<0.001***
3rd term final	0.012	<0.001***

Statistical analysis was done by Pearson's correlation coefficient test (r)
***: Significant

Discussion:

Assessment methods in medical education used to test the knowledge acquired and the ability to apply such knowledge[10]. A study conducted on 100 MBBS students of medicine for 100 MCQs, 48.90 ± 13.72 mean Difficulty Index (DIF-I) was reported by researcher[24]. In this present study-among all term final examination, majority (70%) of MCQ were in the acceptable range (30-70%) and only one (5%) item was difficult (< 30%).To discriminate between skilled and unskilled examinees, Discrimination Index (DI) is another important tool of MCQ analysis. DI of MCQ of internal examination, majority of the MCQ 13 (65%) was excellent (≥0.35), 9 (45%) was average (0.20-0.34) and 1 (5%) was poor (<0.20).A study by one author found Singh et al. (2012)after analysis of 20 MCQs reported more than one third (30%) of the items with DI < 0.2, and half 10 (50%) of the test items with DI > 0.35, results compared to our present study[25].

In this study, mean percentage of scores of SAQ of internal examination 68.01% and 36.67%were allocated for recall and understanding types of questions respectively. No mark was allocated for problem based type of SAQ in 1st term final. Therefore, significantly highest scores of SAQ 2.41% in 2nd term and 1.98% in 3rd term was allocated for problem based questions. Frequency distribution of SAQ of internal examination majority found, 13 (24%) was excellent, 6(11.1%) was average and1 (1.9%) was poor. Internal assessment marks showed a positive correlation with MCQ and SAQ written assessment method which was highly significant (p value <0.001).

The percentage of marks allocated for recall and understanding type of questions follow the curriculum directed weightage but problem based questions not follow the direction.In this new curriculum, the written examination format was modified to SAQ and MCQ along with 10% mark added for formative assessment.[1,2] After success-fully complete internal assessment 1st, 2nd& 3rd term) medical students have been appeared in 1stProfessional MBBS Examination.[4]

Written examination consists of two papers and in each paper 70% marks were allocated for SAQ and 20% marks for MCQ. To assess different cognitive domains of students in physiology, while constructing questions for SAQ, the curriculum has recommended, 70% marks for recall, 20% for understanding and 10% for problem based learning (PBL) types of questions.This similar evidences were found in this study also observed by other researchers.[1-4]

Several studies found that interpreting tools of assessment related with comparison and correlation. The author stated that a total of 30 SSAQs (structured short answer questions) and 100 MCQs of five items were analyzed. The difficulty index of MCQ and SSAQ was 0.36 and 0.38, respectively. SSAQ showed higher discrimination index (0.46-very good item) than MCQ (0.29-marginal item), SSAQ a better tool to discriminate poor and good students than MCQ.[7]There are similar evidences observed by other researchers that awell-constructed MCQ is superior in terms of the higher cognitive skills of medical students.[3,13]Moreover, when combined assessment tools are analyzed, found MCQ were the best examination tools to distinguish poor from medium and excellent students. These findings also similar in this present study. [5,8]

The main drawback of SAQ type question is that it is not easily computerizedfor assessing a large number of medical students. This study reported by different investigators, though difficulty index of SAQ and MCQ are similar, SAQ was a better tool. So, essential task of medical colleges take initiative to develop guidelines on setting up standard questions on basis of learning needs. [12,15] Another study found that the internal assessment marks showed a positive correlation with marks obtained in final assessment which was statistically (p<0.01) highly significant.[9]

The formative or internal assessment has multiple benefits. Its continuous nature throughout course has the potential to drive the students learning in the right way over the time.4Our well designed step by step assessment system that provides timely feedback to students could have contributed to better performance in finals assessment.[6,9]

Sample size of the present study was small. However, further research can be done with a larger sample size. It is concluded from the present study that majority of the test items were within the recommended values.

Conclusion

In this study, it is concluded that there is a positive significant correlation between performance of students in internal assessment through written format (MCQ and SAQ).This marks in internal assessment are related to better marks in 1st professional MBBS examination.

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