

Research Article

Application of blooms taxonomy of verbs to evaluate the cognitive domain in undergraduate medical physiology question papers: a critique

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ABSTRACT

Background: Over the years medical education has evolved in the system of education, teaching and evaluation. It is the evaluation system that has the most insightful impact on learning. This study aimed to assess the use of taxonomy of verbs in medical physiology question papers as a tool for written examination for summative evaluation of I year medical students.

Methods: Retrospective analysis of I MBBS undergraduate question papers of revised scheme Rajiv Gandhi University of health sciences, Bangalore from the year 2006- 2014 was done. Questions were analyzed individually for the use of taxonomy of verbs in each question, marks allotted for each, and type of cognition analyzed from each question. The data was classified using a modification of Bloom's hierarchy of cognitive learning (level I, II, III).

Results: Majority (45%) of the questions in the papers had no use of verbs. There was variability in the distribution of marks on various chapters of Physiology across the years. Comprehension and knowledge component of the cognitive domain were maximally assessed in the written examination.

Conclusions: Examination and evaluation though a source of anxiety for the undergraduate medical students, it is essential to stimulate their cognitive skills by teaching and enhance the evaluation of mental and reasoning skills. It could be more facilitated by proper framing of questions by adequate usage of verbs.

Keywords: Summative evaluation, Physiology, MBBS, Taxonomy, Cognitive

INTRODUCTION

Knowledge is the essential prerequisite for all types of assessments for any medical students. The system used for assessing them has a powerful influence over learning.¹ It has been publicized that it is the evaluation system rather than educational objectives, curriculum or teaching techniques that have intense impact on what the students eventually learn.² Each learning objective of a subject belongs to a specific domain of learning. The Blooms taxonomy mentions that the educational

objectives are mainly framed in three domains: Cognitive, Affective and Psychomotor.³ A medical undergraduate student is assessed to capture these learning objectives and there in to see if a learner has acquired the requisite knowledge, can perform must know skills and has developed adequate attitudes.

At undergraduate level of evaluation of medical students in India, the cognitive domains can be evaluated at different levels including knowledge, comprehension, application, analysis, synthesis and evaluation.⁴ This

domain is further classified in three levels (Figure 1). In medical education, the foremost importance at the end of the course is on developing and evaluating the level III or analysis, synthesis & evaluation skills. However, correct cognitive assessment tools reward the students for their higher cognitive skills, conceptual judgment and attaining sound knowledge.⁵

In the summative evaluation, of the phase I of Medical course on Karnataka, Rajiv Gandhi University of medical sciences (RGUHS); the learner knows, understand or can do a predetermined thing, and qualifies to advance to higher levels of responsibility. The cognitive domain is assessed in written examination by answering theory question papers which include free response Long Essay Questions (LEQ), Short Essay Questions (SEQ) and Short answer Questions (SAQ). Along with this the skills and affective domain are assessed with practical examinations and viva voce.⁶ Each of this method of evaluation is unique and probably a reliable and convincing evaluation requires a mixture of these methods.⁷ Also as per the Miller's pyramid knowledge and competence are best assessed through written examination.⁸

However construction of the questions is an important component of these exams and very little is spoken about it in the literature. Validity is that it should truly measure what it is intended to measure. Content validity correctly judges the knowledge, the skill of the learner and desire to have a good coverage of contents in the test.⁹ Though open ended question like LEQ & SEQ are flexible, they have lower reliability.¹⁰ However constructing a good question is essential to define the criteria on which the answer will be judged. They are ideal for assessing how well a student can summarize, find associations, apply measures and give insight on writing aptitude to route information. Unfortunately a little attention is paid to the attributes of a good question paper by most of the paper setters.

Thus this study was conducted to retrospectively evaluate the use of blooms taxonomy of verbs in the question paper which are used as an assessment tool in the evaluation of undergraduate medical students in a view to know the level of cognition and the type of domain being tested of the subject Physiology in undergraduate question papers (MBBS) set by RGUHS, Bangalore, India.

METHODS

This study was conducted at the Physiology department, SS Institute of Medical Sciences and research centre, Davangere, Karnataka. The Health University of Karnataka, i.e. Rajiv Gandhi University of health sciences (RGUHS), Bangalore conducts summative assessments twice a year to undergraduate's medical students in physiology. The students are judged by their performance in written examination, viva-voce and

practical examination. Each of these theory papers comprise of 2 long essay(LE)- each carrying 10 marks (20 marks in total), 10 short essays (SEQ)-each carrying 5 marks (50 marks in total) and the 10short answer (SAQ) type of questions- each carrying 3 marks (30 marks in total).

Each paper carries 100 marks and a total of 200 marks for the complete summative evaluation of the subject Physiology. Paper I covers :General Physiology, Blood & Lymph, Cardiovascular system, Respiratory system, Gastrointestinal tract, Kidney / Renal system and paper II contains: Endocrine glands, Special senses, Reproduction, Central nervous system, Nerve & Muscle, Skin & body temperature.

Data collection & compilation

A retrospective descriptive analysis of Physiology previous question papers (2006- 2014) of the first year MBBS students exams (revised scheme 2 & 3) were collected and analysed.

Question papers of Physiology of the first M.B.B.S examination of RGUHS from 2006 to 2014 (9 years) were examined. A total of thirty six (36) question papers were analysed. Each question paper has 22 parts and since there are 2 papers it comprises of 44 parts per exams. With two exams per year, and for nine years a total of 792 parts was analysed for the variables. Frequencies in terms of marks of different aspects of Physiology covered in each topic (expressed as percentage of total number of segments of questions) were recorded. The coverage of different chapters of physiology in written examination was entered on an excel sheet and its comparison with the recommended marks (as per the RGUHS syllabus), teaching hours devoted to each topic was estimated.

Each question was evaluated to measure the type of domain and the level of cognition was determined. Essay questions, short essays and short answers were categorized according to the cognitive level measured by each question. The verbs which were used for these questions for behavioural objectives were used to categorize the questions classification and understanding the use of Bloom's hierarchy of cognitive learning in the assessment papers. For simplicity the data is represented as one year assessment instead of 2 assessments per year

Statistical analysis: The data was compiled in Microsoft excel, presented as tables and graphs and analysed in terms of proportion and represented in percentages.

RESULTS

The RGUHS syllabus truly measures what is intended to measure in terms of content validity. Table 1 illustrates a distribution of marks for each of the system in the RGUHS curriculum. There was a positive correlation

between the hours allotted for didactic lectures to the distribution of marks. Table 3 shows the mean distribution of marks of various systems across the years from 2006 to 2014. A mean difference from -1 to +5 was observed from each system. Also the distribution of marks for each of the chapter of the physiology varied every year, every exam (Figure 2 to 4).

Table 1: System wise distribution of teaching hours as per RGUHS curriculum.

No	System	Hours	Marks
1	General Physiology	8	4
2	Blood and lymph	16	20
3	Cardiovascular System	25	24
4	Respiratory System	12	20
5	Gastro intestinal	12	20
6	Kidney	10	12
7	Endocrine	16	20
8	Special Senses	10	20
9	Reproduction	10	12
10	Central nervous system	30	28
11	Muscle nerve	8	16
12	Skin Body Temperature	2	4

Based on the usage of key verbs (Table 2), the cumulative examination questions on an average focused more on comprehension (28%), followed by knowledge (14%), application (6%), analysis (5%), synthesis(2%) and none on evaluation. It was interesting to note that 45% of the questions had no usage of any verbs (figure 3). The questions were vague, for example: acromegaly, sarcomere, neuromuscular transmission, etc. Out of questions which had definite verbs, the maximum proportion focused on level I & II of the Blooms hierarchy cognitive domain.

DISCUSSION

Written assessments in medical colleges is one of the major tools in the scheme of evaluation.¹¹ Some misconceptions exist despite being disapproved repetitively. One such is the conviction that the format of the question determines what actually the question tests. Reliability and validity are two important concepts in this. Also they measure depth of coverage of subject and evaluate the balance of level of cognitive skills to finally bring into line instruction with assessment and outcome of the course.¹²

Usage of verbs is the one of the most important constituent of a performance objective as it identifies what the learner must do to meet the objective.¹³ It has been shown in this study that there is effective use of verbs in the questions but not all questions have followed such a pattern. The language used in the question paper should be explicit. A few questions for SEQ were like

erythroblastosis fetalis, venous return, which do clearly specify what is actually expected from the students, the same question could have been made very clear by asking: discuss the causes and complications of erythroblastosis fetalis, summarize the factors affecting venous return. Also care could even take on the quality of questions in terms of item analysis. The difficulty index, discrimination index and the effectiveness of each question would definitely help firstly to separate the best students from the average students and also it would make sure of objectivity, validity and feasibility of the evaluation system.

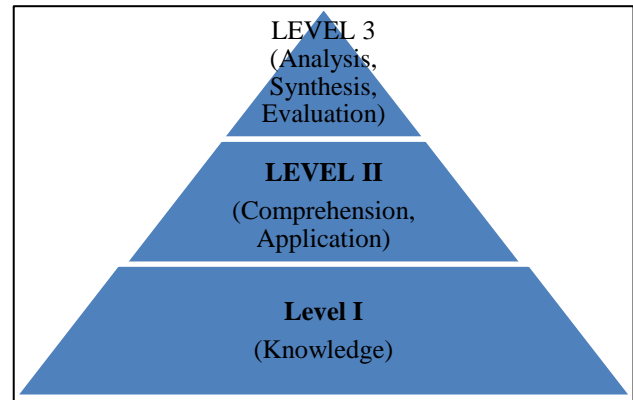


Figure 1: Modified Bloom's hierarchy of cognitive learning.

Additionally, studies have stated that the examination should be designed to assess the individual candidates' ability to meet the course objectives or curriculum outcomes and should cover the main contents of the course; also adequate coverage of course content is necessary for the validity of assessment.¹⁴⁻¹⁶ Content validity is one of the major types of validity. It refers to the extent to which a test or examination actually measures the intended area. For an examination to have content validity, it must have item validity and sampling validity.¹⁷ The summative evaluation is so designed to measure knowledge of the human physiology if all the questions deal with facts pertaining to the human body systems.¹⁸ However, poor sampling validity will be apparent if all the questions focus on the limited body systems. It is also based on subject expert judgment, and measures the degree to which the assessment contains a representative sample of material taught in the course and should cover important skills abilities.¹⁹⁻²² Our study agrees to these definitions and this is well followed in the RGUHS curriculum though not consistent.

The aim of essay questions and short answers is to broadly measure both the absolute amount of knowledge retained by the candidate and the ability of the candidate to use that knowledge to reason through and evaluate clinical problems. Through these stages, a candidate's ability to understand, reason, evaluation is tested. Our observations in RGUHS physiology medical question

papers have reinstated these impressions which vary in percentage.

Much of the power of Bloom's Taxonomy lies in its verbs. The verbs associated with each cognitive level identify what students can do to demonstrate that they have met objectives. The secret of configuration, whether at the lesson or program level, is to choose verbs that

correlate instructional goals with content and assessment. Its objectives are limited to the knowledge level, but its goals include mastery of higher-order skills that participants may not have learned or practiced. If instruction is limited to the knowledge level and participants must use higher-order skills to show mastery, the misalignment between lower-level instruction and higher-level assessment sets learners up to fail.²³

Table 2: Verbs for use in writing behavioural objectives of questions.

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
define	discuss	compute	distinguish	diagnose	evaluate
list	describe	demonstrate	analyse	propose	compare
recall	explain	illustrate	differentiate	design	assess
name	identify	operate	compare	manage	justify
recognize	translate	perform	contrast	hypothesize	judge
state	restate	interpret	categorize	summarize	appraise
repeat	recognize	apply	appraise	compose	rate
record	express	employ	calculate	plan	revise
label	locate	use	test	formulate	score
diagnose	report	practice	criticize	arrange	select
tell	schedule	diagram	assemble	choose	
transform	sketch	inspect	collect	estimate	
convert	prepare	question	construct	measure	
distinguish	modify	relate	create	argue	
estimate	predict	solve	organize	decide	
extrapolate	examine	prepare	criticize		
manage	classify	modify			
deduce	invent				
outline	generate				

Table 3: Average marks and percentage of distribution of marks of different systems of physiology in the question papers.

chapters	RGUHS		2006-2012		Difference	
	marks	% distribution	mean marks	% distribution	marks	% distribution
General Physiology	4	2	5	3	-1	-1
Blood and lymph	20	10	17	9	3	1
Cardiovascular System	24	12	25	12	-1	0
Respiratory System	20	10	18	9	2	1
Gastro intestinal system	20	10	19	9	1	1
Kidney	12	6	16	8	-4	-2
Endocrine	20	10	25	13	-5	-3
special sense	20	10	16	8	5	2
Reproductive system	12	6	13	6	-1	0
Central nervous system	28	14	29	15	-1	-1
Muscle nerve physiology	16	8	13	6	3	2
Skin & body Temperature	4	2	3	2	1	0

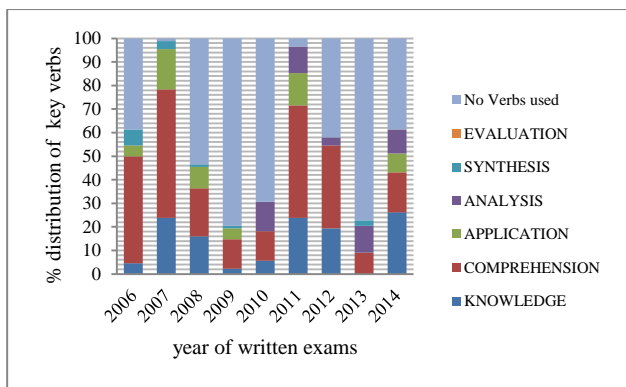


Figure 2: Percentage of distribution of use of key verbs to define the various cognitive domains assessed in the physiology question papers.

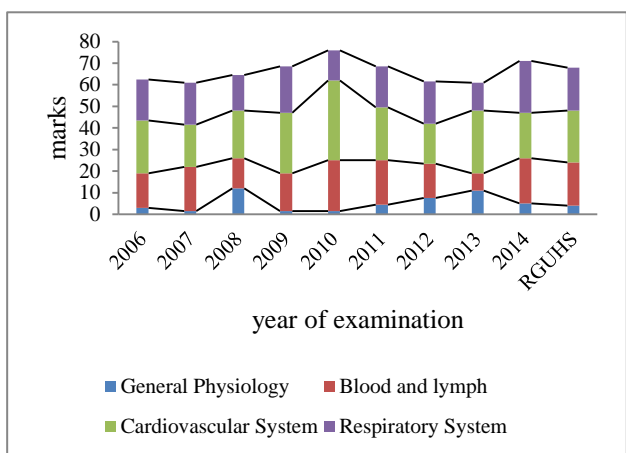


Figure 3: Blood and lymph, Cardiovascular System, Respiratory System.

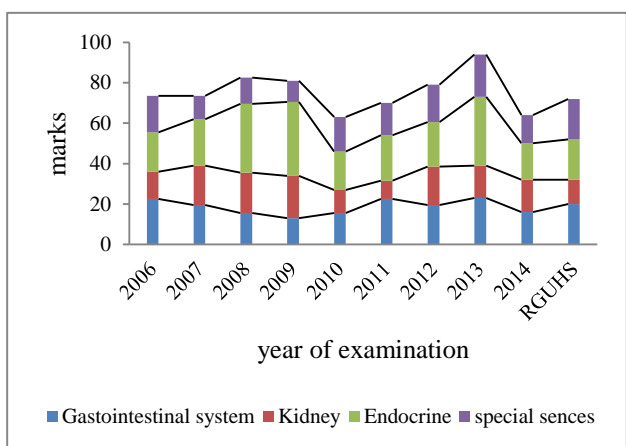


Figure 4: Kidney, endocrine, special sense.

Therefore, it may be concluded that the question setting procedure of the written examination according to the modern assessment technique has been partially fulfilled. Additional preparation would meet the three criteria for selecting verbs for performance objectives. They must be measurable and observable, specify what the learner (not

the instructor) does and it requires the learner to apply the learning. Thus, it is suggested that, proper orientation and execution of the educators are vital to get the desired benefit from the present undergraduate Physiology written assessment system.

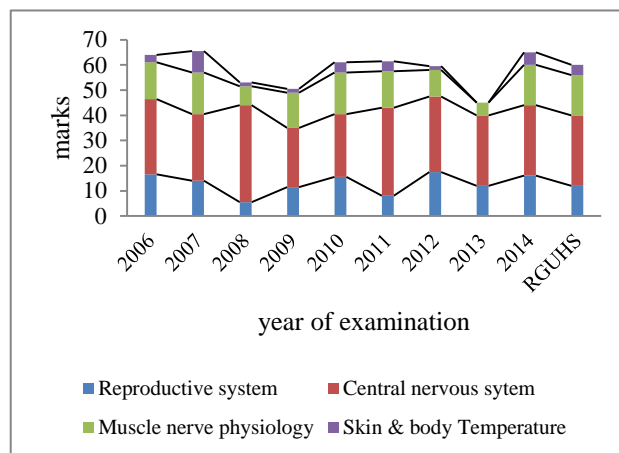


Figure 5: Distribution of marks in the question papers for chapters: reproductive system, central nervous system, muscle nerve physiology, skin & body temperature.

CONCLUSION

Question paper and its evaluation have been and will remain a fundamental part of education to class the students with their performance towards learning and to meet the requirements of the goals & objectives of the medical council. Question paper setter and evaluator generally fulfil their tasks with great integrity. Though the seriousness of framing the questions is important and is being stressed, less is followed. Yet it is great challenge to our education system, its planners and pillars (teachers) to pay attention to the taxonomy of verbs in framing the questions and meet the said goals.

Content validity and summative evaluation done as part of medical education sets up a module at the university level and helps in changing our teaching and training methods. This makes better doctors. It is an exit assessment process and so needs to be appropriately designed. Through assessment, educators meet responsibilities to students and to the public and society at large.

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