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Original Research Article

Item analysis of multiple choice questions of undergraduate pharmacology examinations in a medical college in Belagavi, Karnataka, India

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ABSTRACT

Background: Multiple choice questions (MCQs) are a common method of assessment of medical students. The quality of MCQs is determined by three parameters such as difficulty index (DIF I), discrimination index (DI), and Distractor efficiency (DE). Item analysis is a valuable yet relatively simple procedure, performed after the examination that provides information regarding the reliability and validity of a test item. The objective of this study was to perform an item analysis of MCQs for testing their validity parameters.
Methods: 50 items consisting of 150 distractors were selected from the formative exams. A correct response to an item was awarded one mark with no negative marking for incorrect response. Each item was analysed for three parameters such as DIF I, DI, and DE.
Results: A total of 50 items consisting of 150 Distractor s were analysed. DIF I of 31 (62%) items were in the acceptable range (DIF I= 30-70%) and 30 had 'good to excellent' (DI >0.25). 10 (20%) items were too easy and 9 (18%) items were too difficult (DIF I <30%). There were 4 items with 6 non-functional Distractor s (NFDs), while the rest 46 items did not have any NFDs.
Conclusions: Item analysis is a valuable tool as it helps us to retain the valuable MCQs and discard or modify the items which are not useful. It also helps in increasing our skills in test construction and identifies the specific areas of course content which need greater emphasis or clarity.

Keywords: Difficulty index, Discrimination index, Distractor efficiency, Multiple choice questions, Non-functional distractor

INTRODUCTION

Assessment is an integral part of curriculum and is used to guide future learning (formative assessment) or to judge competence to practice (summative assessment).

Multiple choice questions (MCQs) are a widely used tool in assessment protocols. MCQs have the advantage of having a high degree of objectivity and reliability and can assess a large area of the content in a small time-span.[1] Medical education technology recommends the implementation of standard pre-validation and post validation protocols to increase the validity of MCQs. Pre-validation prevents errors in framing MCQs by using guidelines and checklists, post validation helps to identify MCQs with questionable validity so that they can be modified before reuse or discarded.[1] Item analysis is a post validation procedure that characterizes every MCQ and its Distractor s by assigning a numerical value to it in the form of a difficulty index, a discrimination index and Distractor efficiency.[2] It investigates the performance of items considered individually either in relation to some external criterion or in relation to the remaining items on the test.[3] These analyses evaluate the quality of items and of the test as a whole.

It also tells how difficult or easy the questions were, the difficulty index, and whether the questions were able to

discriminate between students who performed well on the test, from those who did not, the discrimination index.[4] Another important technique is analysis of Distractors, that provides information regarding the individual Distractors and the key of a test item.[5] Based on standard acceptable limits of these indices MCQs can be either accepted for banking or modified and revalidated or discarded. With this background this study was conducted to perform an item analysis of MCQs for testing their validity as an assessment tool.

METHODS

Assessment by MCQs is one of the modes of evaluation in the institution where this study was carried out. 50 MCQs were picked from the sessional examination. All MCQs had single stem with four options/responses including one being correct answer and other three Plausible Distractors. Based on the scores, they were arranged in a descending fashion with the highest score on top and the least score at the bottom. Then they were divided into three groups. The upper third and lower third were included in the analysis and designated as high scoring group and low scoring group respectively. The responses chosen by each student for every question was entered in Microsoft excel 2010. Difficulty index and discrimination index was calculated. 150 distractors were also analysed to find out the frequency with which they were opted by each student and the number of non-functional distractor s in each item was assessed.

Total 50 MCQs and 150 distractor s were analysed and based on this data, various indices like DIF I, DI, DE, and non-functional Distractor s (NFDs) were calculated with following formulas:[6]

Difficulty index (DIF I) = [(H + L) / N] x100

Where,

N = total number of students in both high and low groups and H and L are the number of correct responses in high and low groups respectively.

It denotes the percentage of students who have chosen the correct option. Higher the difficulty index, easier is the item. It ranges from 0-100%. It was graded as follows: <30%-difficult, 31-40%-good, 41-60%-excellent >61 Easy.[7]

Discrimination index (DI) = [(H-L) /N] x 2

Where,

H=Number of correct answers in high group, L=Number of correct answers in low group, N= total number of students.

It is the ability of an item to discriminate between high scorers and low scorers. It ranges from 0 to 1. Lower scores indicate poor discriminative capacity of the item. It was graded as follows: <0.15- poor, 0.15-0.24-good, more than or equal to 0.25-excellent.[7]

Distractor efficiency (DE) is determined for each item on the basis of the number of NFDs in it and ranges from 0 to 100%. If an item contains three or two or one or nil NFDs then DE will be 0, 33.3, 66.6, and 100%, respectively.[7,8]

RESULTS

The current study aimed to carry out a post-validation item analysis of multiple choice questions (MCQs) in medical examinations in order to evaluate correlations between item difficulty, item discrimination and distraction effectiveness so as to determine whether questions should be included, modified or discarded.

Table 1: Assessment of 50 items based on various indices amongst 120 students.

Parameter	Mean±SEM
Difficulty Index (DIF I)%	12.5±3.17
Discrimination Index (DI)	16.67±6.6
Distractor efficiency (DE)%	2.6±0.6

Total numbers of students were 120, 60 students were included each in high and low scoring group respectively. 50 multiple choice questions from the examinations conducted in the department were selected and each correct response was awarded score of one. There was no negative marking for the incorrect answer. 50 multiple choice questions with a total of 150 Distractor s were analysed in this study. The distribution of difficulty and discrimination indices of the 50 MCQs given and their corresponding DE was also worked out.

Table 2: Distribution of Items according to difficulty and discrimination indices and their actions proposed.

Cut off points	Items (N= 50)	Interpretation	Action
Difficulty Index (DIF I)			
≤30	09	Difficult	Revise
31-40	09	Good	Store
41-60	22	Excellent	Store
≥61	10	Easy	Revise
Discrimination Index (DI)			
<0.15	11	Poor	Revise
0.15- 0.24	09	Good	Store
≥0.25	30	Excellent	Store

In present study, mean and standard deviations (SD) for difficulty index (%), discrimination index and Distractor efficiency (%) were 12.5±3.17%, 16.67±6.6, and 2.6±0.6%, respectively (Table 1). Out of 50 items, 22 had excellent level of difficulty (DIF I = 41-60%) and 39 had "good to excellent" discrimination power (DI ≥0.15) (Table 2). 18% of the questions had a difficulty index

ranging between 31-40% and 44% had DIF I range between 41-60%. The difficulty index was less than 30% for 18% items and 20% of the questions were easy as they had a difficulty index more than 61%. However, if only the items with "good to excellent DIF I and excellent DI (≥0.25) are considered, there were 20 items as ideal. Distractor analysis gives an opportunity to study the responses made by the students on each alternative of the item. Out of 150 distractor s, 06 (12%) were NFDs present in 04 items, where two items had 1 and two items had 2 NFDs, with DE varying between 33 and 66%. Remaining 46 items had no NFDs with their DE being 100% (Table 3 and 4).

Table 3: Distractor analysis (N =150).

Variables	Value
No. of Items	50
Total distractor s	150
Functional distractor s	144
Non-functional distractor s	06 (12%)
Items with 1 or 2 NFDs	04
Items with 1 NFDs (DE= 33.3%)	02
Items with 2 NFDs (DE=66.6%)	02
Items with 0 NFDs (DE=100%)	46
Overall mean DE	2.6±0.6

Table 4: Items with non-functional Distractors (NFDs) and their relationship with DIF I and DI.

DIF I (%)	Item with NFDs	DI	Item with NFDs
≤30	2	<0.15	1
31-40	-	0.15-0.24	2
41-60	1	≥0.25	1
≥61	1		

DISCUSSION

Any assessment has intense effect on learning and is an important variable in directing the learners in a meticulous way.

Single correct response type MCQ is an efficient tool for assessment; However, this efficiency solely rests upon the quality of MCQ which is best assessed by the analysis of item and test as a whole together referred as item and test analysis.[6] Each item (MCQ) while being used in assessment must be evaluated based on DIF I, DI, and DE because if an item is flawed then this itself becomes distracting and the assessment can be false.[2] In this study, the item analysis of multiple choice questions was done to evaluate the difficulty index and discrimination index of 50 items.

Results revealed that the percentage of MCQs that were in the acceptable range based on the difficulty index, discrimination index and Distractor efficiency were 62%, 78% and 30% respectively while 92% of the Distractor s were functional (acceptable). This shows that majority of the questions were in the acceptable range i.e. neither too easy nor too difficult. However, 09 items were difficult, and 10 items were easy for the students. Too easy items should be placed either at the start of the test as 'warm-up' questions or removed altogether, similarly difficult items should be reviewed for possible confusing language, areas of controversies, or even an incorrect key.[7] The easy items can be reframed to boost the confidence of the students. Thus, these MCQs and Distractor s can be added to the question bank while the rest have to be modified or replaced and retested until they satisfy the criteria of acceptability.

In a study conducted by Karkal et al, on 488 items showed that 56.96% items had a difficulty index ranging between 30%-70%, 23.3% items were easy and 5.53% were difficult.[9] In a study by Halikar S et al, item analysis of twenty MCQs in ophthalmology was performed. Results showed that the percentage of acceptable MCQs based on difficulty index and discrimination index were 35% and 50% respectively. The percentage of functional distractors in this study was found to be 23%. The authors concluded that item analysis could generate a bank of validated MCQs with known values of indices from which question paper setters can choose the appropriate MCQs for a given examination.[10]

Analysing the Distractors (incorrect alternatives) is done to determine their relative usefulness in each item. Items need to be modified if students consistently fail to select certain Distractors.[11] Such alternatives are probably implausible and therefore of little use as decoys. Therefore, designing of plausible Distractor s and reducing the NFDs is an important aspect for framing quality MCQs.[12]

Assessment of MCQs by these indices highlights the importance of assessment tools for the benefit of both students and teacher. Item analysis when regularly incorporated can help to develop a very useful, valid and a reliable question bank with MCQs categorized into easy, difficult and ideal questions.[2]

CONCLUSION

Item analysis is a simple, yet valuable procedure performed after the examination providing information regarding the reliability and validity of an item/test by calculating DIF I, DI, and DE and their interrelationship. An ideal item (MCQ) will be the one which has average difficulty (DIF I between 31 and 60%), high discrimination (DI ≥0.25) and maximum DE (100%) with three functional Distractors. While preparing ideal items, level of preparedness of students must be kept in mind and more efforts be made to replace NFDs with ideal/plausible Distractors.

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