

Original article:

Validation of Physiology MCQs using Item Analysis method

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Abstract

Background: Objectivising evaluation is gaining importance in the field of medical education. Multiple Choice Questions [MCQ] are the most popular form of this evaluation. It is the most frequently used tool to assess different learning domains of the students. However, the MCQ which is used must be of quality & should serve its purpose, which in turn depends upon its difficulty & discrimination index. So the present study was undertaken to focus on MCQ validation & emphasize the importance of item analysis.

Aim: The aim was to find difficulty & discrimination index of all MCQs each considered individually as an item. This would in turn validate all MCQs.

Methodology: A total of hundred & fifty students underwent MCQ test as part of their periodic assessment. A MCQ test was given to students and a post-test validation was done through item analysis. The indices were calculated using Microsoft excel and were compared.

Results: After item analysis the difficulty index of 73 % items and discrimination index of 71 % items was in the acceptable range. In spite of using a well-designed MCQ test prepared by senior faculty and colleagues, 27% and 29% of items had difficulty and discrimination index respectively which were not in the acceptable range.

Conclusions: Item analysis must be considered for validation MCQs. A validated MCQ question bank should be made for the assessment of students.

Key Words: Item analysis, MCQ validation, Difficulty index, Discrimination index

Introduction

Evaluation is the most important aspect of teaching– learning process (1, 2). It not only helps in determining whether pre- determined educational objectives are achieved or not, but also helps in modification of the same objectives. A multiple-choice question (MCQ) is one of the most important tools for evaluation. It is an item consisting of 2 components namely, i) Stem, which includes facts or question presented to the examinee; ii) Responses having 2 sub-components a) the correct answer known as key, and b) the alternatives or the options known as distracters. (3,4).

The two most important characteristics of any tool are its reliability and content validity. The reliability & validity of MCQ can be determined by systematic appropriate selection of items with regard to its subject matter, degree of difficulty & discrimination. Thus the quality and effectiveness of a MCQ depends upon the individual item which in turn is determined by item analysis. (2) Item analysis is the validation of MCQs after it has appeared in a question paper. (5) This post validation involves process of collection and using responses given by the students in assessing the quality of the test items. Thus it ensures whether

the given item is of an appropriate standard for its inclusion in a test, or if it needs alteration. (6)

So the present study was undertaken to assess the importance of item analysis with the following objectives.

Objectives

1. To find out the difficulty and discrimination index of an individual test item.
2. To validate different items.

Material and methods

The study was conducted in the Department of Physiology, Indira Gandhi Govt. Medical College, Nagpur as a part of periodic assessment. Hundred & fifty First-year MBBS students were voluntarily involved in the study. They were given the MCQ test paper consisting of sixty [60] questions with single best response covering entire syllabus of Physiology. The MCQs' were constructed to assess various levels of knowledge according to Bloom's Taxonomy (7). These MCQs' were prepared by the senior faculty in the department. There was no negative marking and the time allotted was sixty minutes. Evaluation was done out of sixty marks

and validation of the MCQs' was done using item analysis(5).

Item analysis is the statistical analysis of objectively marked items which enables the test constructor to identify the effectiveness of their test items. It mainly involves the following two important characteristics of each item i) Level of Difficulty or item difficulty and ii) Discriminating power of the test items or item discrimination. Item difficulty is the proportion of the examinees that marked the item correctly. It is expressed in terms of percentage of students ranging from 0% - 100%. While the term item discrimination indicates to what extent the response to an item could distinguish between the strong and the weak examinee. It is expressed between zero to 1.00.(8, 9, 10)

Steps in item Analysis: The scores of all the students were arranged in descending order of merit. Then they were divided into three groups as low, moderate & high achievers in accordance to their marks. Top one third students were considered as high achievers H [n=50] and bottom one third group as low achiever's L [n=50].

Each item then was analysed for the Difficulty & discrimination index.

1. Calculation of Difficulty Index
p value was calculated using the formula

$$\text{Difficulty index (\%)} = \frac{H + L}{N} \times 100$$

Where

- H= number of students answering the item correctly in high achievers group.
- L= number of students answering the item correctly in the low achievers group.
- N= Total number of students in the two groups (including non-responders).

Difficulty index (%)	Item Interpretation
< 30%	Too Difficult
30 – 70 %	Acceptable
50 - 60 %	Ideal
>70 %	Too Easy

Items having difficulty index (%) less than 30% & more than 70% are not acceptable and needs modification.

2. Calculation of Discrimination index

$$\text{Discrimination index} = \frac{H-L}{N} \times 2$$

Where the symbols H, L and N are same as above.

Discrimination index	Item Interpretation
< 0.20	Poor
0.20-0.35	Good
>0.35	Excellent

Items with d value less than 0.20 are not acceptable & needs revision.

RESULTS

1] Difficulty Index of items analyzed

After individually analyzing the items it was observed that the difficulty index of 44 items (73.33%) were acceptable. 8 items were too easy and 8 were too difficult. These 16 items (26.66%) could be used after modification. [Table 1 & 2]

2] Discrimination index of items analyzed.

The discrimination index of 43 items (71.66%) was acceptable but 17 items (28.33 %) need revision.

[Table 3 & 4]

Table 1: Difficulty Index of items (1-60)

No.of Item	Difficulty index (%)	No.of Item	Difficulty index (%)	No.of Item	Difficulty index (%)	No.of Item	Difficulty index (%)
1	61	16	56	31	24	46	38
2	29	17	79	32	50	47	33
3	46	18	25	33	43	48	74
4	13	19	20	34	47	49	45
5	36	20	88	35	59	50	39
6	66	21	34	36	52	51	87
7	43	22	55	37	66	52	48

8	34	23	88	38	49	53	52
9	65	24	48	39	39	54	39
10	68	25	36	40	86	55	30
11	39	26	13	41	93	56	59
12	79	27	65	42	65	57	56
13	68	28	49	43	34	58	55
14	13	29	33	44	64	59	33
15	61	30	37	45	30	60	20

Table 2: Difficulty Index (DI) of items analysed.

DI Range	Number of items	Interpretation	Action taken
30 to 70 %	44(73.33%)	Acceptable	In MCQ bank
>70 %	8(13.33%)	Too easy	Revise
<30 %	8(13.33%)	Too difficult	Revise

Table 3: Discrimination Index of items (1-60)

No. of Item	Discrimination index (%)	No. Of Item	Discrimination index (%)	No. of Item	Discrimination index (%)	No. of Item	Discrimination index (%)
1	0.46	16	0.24	31	0.08	46	0.28
2	0.5	17	0.34	32	0	47	0.1
3	0	18	0.26	33	0.38	48	0.32
4	0.1	19	0.12	34	0.34	49	0.34
5	0.4	20	0.12	35	0.26	50	0.42
6	0.36	21	0.28	36	0.36	51	0.1
7	0.42	22	0.5	37	0.12	52	0.24
8	0.16	23	0.16	38	0.34	53	0.32
9	0.26	24	0.28	39	0.34	54	0.34
10	0.24	25	0.2	40	0.08	55	0.16
11	0.38	26	0.06	41	0.1	56	0.46
12	0.22	27	0.38	42	0.38	57	0.28
13	0.32	28	0.26	43	0.24	58	0.46
14	0.02	29	0.34	44	0.28	59	0.22
15	0.42	30	0.1	45	0.28	60	0.2

Table 2: Discrimination index of items analyzed

Range	Number of items	Interpretation	Action taken
0.2 to 0.35	28	Good	In MCQ bank
>0.35	15	Excellent	In MCQ bank
<0.2	17	Poor	Revise

Discussion

To develop a perfect, flawless test is a daunting task for teachers. In this regard, item analysis provides an insight into the quality, validity, reliability & utility of test items via the values of difficulty & discrimination index. (2,11).

We found that out of 60 items only 44 items (73.33%) in terms of difficulty index & 43 items (71.66%) in terms of discrimination index were in acceptable range. The remaining items needed modification. Similar results were depicted in other studies like Mitra, N.K et al.(12) & Sim et al (13). Thus our study demonstrates that validation of MCQs using item analysis is important in assessing

effectiveness of a particular MCQ as an evaluation tool.(10).

Conclusion

Item analysis gives us an idea regarding item ambiguity, ineffective distracters, and other technical defects missed during the preparation of the test. So by knowing them we become more cognizant about the obstacles in preparing good MCQ and how to remove them by repeating the item analysis after modifying the question. Item analysis must be considered for validation MCQs. A validated MCQ question bank should be made for the assessment of students. Item analysis can be done in other subjects to develop a good item bank.

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