An Original Research Work
On

Item Analysis of Multiple Choice Questions Given to First Year Medical Students–Concept Building and MCQ$_S$

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Abstract:
Objective questions in MCQs are made up of short questions called as Items or Multiple choice items (MCQs) that are typically composed of questions that require a candidate to select one clearly correct answer called as single best response from among those provided. They consist of STEM that sets up the situation for response, followed by series of one correct and remaining 3 incorrect answers. The incorrect options are called as DISTRACTORS. These DISTRACTORS should embody misconceptions partly correct answers and common errors of fact or reasoning that they distract students that are not well prepared for test. Specific and clear instructions should be included.
Objectives:
1.To design a better question paper in subsequent exams.
2.To detect technical flaws.
Settings:
Study was conducted in anatomy department of Lokmanya Tilak Municipal Medical College, Sion, Mumbai.
Materials and Methods:
The study was conducted after obtaining permission from Head of Anatomy department and Institutional Ethics Committee. MCQ answer sheets of 100 First year MBBS students appearing in preliminary exam in April 2009 were analyzed.
Statistical Analysis:
Data was entered and analyzed in MS Excel 2007 and simple proportions and means were calculated.
Results:
The mean p value in this study was 69.8% which is a little more than the range specified by Others 41–60%.
The mean Discriminating index in this study was 0.22 which is more than the acceptable cut off point of 0.15.
In this study, 12.5 % items have less effective distracters.
Conclusion:
Study emphasizes the selection of quality MCQs which truly assess the knowledge and are able to differentiate the students of different abilities so as to implement new strategies to encourage weak students for better understanding of the subject.

Keywords: *Difficulty index, Discrimination index, Distractor efficiency, Multiple choice question or item, Nonfunctional distractor (NFD*

1. Introduction

Multiple choice questions (MCQs) are frequently used to assess students in different educational streams for their objectivity and wide reach of coverage in less time.[1] Objective questions in MCQs are made up of short questions called as Items or Multiple choice items (MCQs) that are typically composed of questions that require a candidate to select one clearly correct answer called as single best response from among those provided. They consist of STEM that sets up the situation for response, followed by series of one correct and remaining[3] incorrect answers. The incorrect options are called as DISTRACTORS. These DISTRACTORS should embody misconceptions partly correct answers and common errors of fact or reasoning that they distract students that are not well prepared for test. Specific and clear instructions should be included.[2,3,4,5,6]

2. Item Analysis[7]

Information of the quality of an exam is useless if this knowledge cannot be translated into a means for improving subsequent examinations. Data can be calculated in case of Multiple Choice Questions to improve the exam. ITEM ANALYSIS is defined as - The group of statistical techniques applied to items on Multiple Choice Questions exams in order to improve the assessment.

3. Aims and Objectives of this study

1. To design a better question paper in subsequent exams.
2. To detect technical flaws.
3. Materials and Methods

The study was conducted after obtaining permission from Head of Anatomy department and Institutional Ethics Committee of Lokmanya Tilak Municipal Medical College, Sion, Mumbai. Data collected from Preliminary examination conducted after regular teaching in the subject of Anatomy during 1st MBBS (April 2009) which was attended by 100 students. Total 40 MCQs or items and 160 distractors were analyzed. Total duration for examination was 40 minutes and each item was allotted 1 mark. All MCQs had single stem with four options/responses including, one being correct answer and other three incorrect alternatives (distractor). Each correct response was awarded 1 marks and each incorrect response was awarded 0. Data obtained was entered in MS Excel 2007 and simple proportions and means were calculated. Score of 100 students was entered in descending order and whole group was divided in three groups. One group consisting of higher marks was considered as higher ability (H) and other group consisting of lower marks was considered as lower ability (L) group.

4. Methodology

Steps for ITEM ANALYSIS:
1. Collection of MCQ response sheets
2. Correction of collected sheets – can be done manually or on Optical Mark Reading (OMR) Scanner.
3. In this study correction was done manually.
4. Arranging MCQ response sheets in rank order from highest marks to lowest marks.
5. Choosing 1/3rd papers form high scores (high achievers group - H) and 1/3rd from low scorers(low achievers group - L) and middle 1/3rd group is kept aside.
6. Preparing a table of each item showing options marked by students in the above two groups and analyze the following points.
a. Calculating the Difficulty index for each item
The percentage of students from both groups opting for a key is difficulty index denoted as 'p'.
'p' = H+L x 100 (low achievers group – L, high achievers group – H,T=Total)
T
If p <30% = item is difficult to answer

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If p >70% = item is easy to answer
If p 50% -70% = item is acceptable

b. Calculating the Discriminating index of each item
This index measures the ability of an item to discriminate between students. It is denoted as 'd'. This index ranges from -1 to +1.
'd' = H-L x 2 (low achievers group – L, high achievers group – H,T=Total)
T
If d >0.35 = item has excellent discriminating power
If d is 0.25-0.35= item has good discriminating power
If d is 0.2-0.25 = item is acceptable

5. Causes for poor Discriminating index
• Ambiguous questions
• Wrong key
• Many correct answers
• Too easy or too difficult questions
• Failure of teaching learning sessions

6. Effectivity of Distractors or Distractor Efficiency
The most difficult task is making a distractor. If a particular distractor is not chosen by even 5% students it is ineffective distractor. Such a distract was noted down and is discussed.

7. Results
In the present study 100 MBBS students from Medical College in Mumbai, who appeared for preliminary examination conducted in Anatomy subject in year 2009 were included. The items analyzed were 40. Data obtained was entered in MS Excel 2007 and analyzed. Score of 100 students was entered in descending order and whole group was divided in three groups. One group consisting of higher marks was considered as higher ability (H) and other group consisting of lower marks was considered as lower ability (L) group.

Table no. 1: Responses marked by students

Option → Question no ↓	a	b	c	d	Not attempted	key
1	1	92	5	2	0	b
2	17	57	1	25	0	b
3	19	6	56	19	0	c
4	1	16	64	19	0	c
5	4	91	2	3	0	b
6	12	13	54	20	1	c
7	0	0	96	4	0	c
8	4	14	65	17	0	c
9	2	2	14	82	0	d

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10	6	88	0	6	0	b
11	4	8	11	77	0	d
12	7	16	65	11	1	b
13	70	15	9	6	0	a
14	80	19	0	1	0	a
15	36	36	10	16	2	b
16	87	8	5	0	0	a
17	92	7	0	1	0	a
18	83	10	1	6	0	a
19	5	7	49	39	0	c
20	1	6	82	11	0	c
21	11	83	4	2	0	b
22	2	2	92	4	0	c
23	0	91	2	7	0	b
24	33	50	12	4	1	b
25	1	4	16	79	0	d
26	95	1	3	1	0	a
27	6	5	39	50	0	c
28	5	86	5	4	0	b
29	4	9	13	74	0	c
30	6	91	1	2	0	b
31	1	10	71	17	1	c
32	76	2	10	12	0	a
33	6	11	80	2	1	c
34	15	80	3	2	0	b
35	3	1	20	76	0	d
36	61	20	7	12	0	a
37	2	2	0	96	0	d
38	98	0	1	1	0	a

39	4	2	42	52	0	d
40	79	3	6	12	0	a

a,b,c,d = MCQ answer options. Key – Corect option to be marked by student.

Table no 2: Total marks of students when sorted in descending order

RN / Item	71	3	49	72	4	56	67	74	94	2	9	14	25	30	38	42	50	51	53	57	64	78	91	12
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
2	1	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	0	1	0	0	0	0
3	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	1
4	0	1	1	0	1	1	1	1	1	0	1	1	0	1	0	1	1	1	1	1	0	1	1	1
5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
6	1	1	1	1	0	1	1	0	1	0	1	0	0	1	1	0	1	1	1	0	1	1	1	1
7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
8	1	0	1	1	1	1	1	0	1	1	0	1	1	1	0	0	1	1	1	1	1	0	0	1
9	1	1	1	1	1	0	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1
10	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
11	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1
12	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	1	1	1	1	1	1	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1
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27	1	1	0	1	0	1	0	1	0	1	1	1	1	0	0	1	0	0	1	1	1	1	0	0
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N	32	32	32	32	32	32	32	32	32	27	27	27	27	27	27	27	27	26	26	26	26	25	25	25	25

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Rn \ Item	66	75	83	98	7	59	70	5	22	45	65	11	79	58	6	24	69
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29	0	0	0	0	1	0	0	0	1	1	0	0	0	1	1	0	0
30	1	1	1	1	1	1	1	1	0	1	1	0	1	1	0	1	1
31	0	0	0	1	0	1	1	0	0	0	1	1	0	1	1	0	1
32	1	1	0	0	1	1	1	1	1	0	1	0	0	1	1	0	0
33	1	1	1	1	0	1	1	1	1	1	1	1	0	1	1	0	0
34	0	1	1	1	1	1	1	0	0	1	0	1	0	1	0	0	1
35	1	0	1	1	1	0	0	0	0	1	0	1	1	0	0	0	1
36	1	0	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0
37	1	0	1	1	1	1	0	0	1	1	0	1	1	1	1	1	1
38	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
39	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	1
40	1	1	1	1	0	1	0	1	0	1	0	1	1	1	1	1	0
Ttl	25	25	25	25	24	24	24	22	22	22	22	21	21	20	19	19	19

Table no 3: Shows High achievers and Low achievers for each item, with p and d value

Sr no.	High Acheivers	Low Achievers	p value	d value
1	33	26	89	0.2
2	22	15	56	0.2
3	26	13	59	0.4
4	26	17	65	0.3
5	33	27	91	0.2
6	23	11	52	0.4
7	33	31	97	0.1
8	26	14	61	0.4
9	31	20	77	0.3
10	33	25	88	0.2
11	29	21	76	0.2
12	4	6	15	-0
13	28	16	67	0.4
14	31	20	77	0.3
15	14	6	30	0.2

16	31	25	85	0.2
17	32	28	91	0.1
18	29	26	83	0.1
19	20	12	48	0.2
20	32	25	86	0.2
21	30	22	79	0.2
22	32	29	92	0.1
23	32	29	92	0.1
24	24	12	55	0.4
25	31	21	79	0.3
26	33	28	92	0.2
27	21	9	45	0.4
28	31	24	83	0.2
29	6	4	15	0.1
30	31	29	91	0.1
31	29	16	68	0.4
32	25	21	70	0.1
33	28	23	77	0.2
34	29	22	77	0.2
35	30	21	77	0.3
36	25	12	56	0.4
37	33	29	94	0.1
38	33	31	97	0.1
39	23	11	52	0.4
40	3	2	8	0.1

8. Discussion

Quality medical care depends upon the development of knowledgeable, skilled, and competent medical personnel. Any assessment whether formative or summative has intense effect on learning and is an important variable in directing the learners in a meticulous way.(8) Single correct response type MCQ is an efficient tool for evaluation;(9) however, this efficiency solely rests up on 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.

In the present study it is observed that number of Not attempted (NA) questions is 7, which is more than 5%. This indicates that either the question was too difficult or it was out of syllabus or was not taught at all. Analysis of items no 6,15,24,31,33 options given were confusing. This confusion could be due to lack of proper understanding of the subject. For item no. 12 the correct answer was not incorporated in the options which is why high and low achievers have failed to mark correct option. There were two options with partly correct answers and students had chosen one of them. Item no.s 12,15,27,29, show discrepancies in the correct key and response marked by students. The table number 2 shows 33 students with maximum marks in High Achiever group and 33 students with low scores in Low Achiever group. The middle group of 34 students out of total 100 students was not considered.

9. Difficulty Index (DIF I)and Discrimination Index(DI)

The p value(difficulty index) was calculated as

'p' = $\frac{H+L}{T}$ x 100 (low achievers group – L, high achievers group – H,T=Total)

And discrimination index was calculated as:

'd' = $\frac{H-L}{T}$ x 2 (low achievers group – L, high achievers group – H,T=Total)

The mean p value in this study was 69.8% which is a little more than the range specified by Others 41–60%.[10] On analysis of each item it was observed that item nos. 12 and 29 were having p value less than 30% which means these were difficult to answer.

Remaining items had p value more than 70% which means these were easy to answer.
The mean Discriminating index in this study was 0.22 which is more than the acceptable cut off point of 0.15.[11]

Table no.3 shows that item nos. 3,8,13,24,27,31,36,39 have d value more than 0.35 which means these items were excellent in discriminating the high achievers from low achievers.

Item nos. 4,9,14,25,35,40 had d value between 0.25 to 0.35 and have good discriminating index.
Item nos. 1,2,10,11,15,19,20,21,28,34 have d value between 0.2 to 0.25 and have acceptable discriminating index.

Item nos. 5,7,16,17,18,22,23,26,29,30,32,33,37,38 have d value less than 0.2 and are poor in discriminating students.

10. Distractors

Analyzing 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. Such alternatives are probably implausible and therefore of little use as decoys.[12] Therefore, designing of plausible distractors and reducing the poor distractor(also called as Non Functional Distractor) is important aspect for framing quality MCQs.[13,14]

In this study, Item nos 7,22,26,37,38 (12.5%)have less effective distractors as they are not attempted even by 5% of students and thus these distractors become in- effective. Remaining items have effective distractors.

11. Conclusions

Study emphasizes the selection of quality MCQs which truly assess the knowledge and are able to differentiate the students of different abilities so as to implement new strategies to encourage weak students for better understanding of the subject.

Such analysis will improvise the knowledge of students as the questions are framed in such a way that all details are incorporated.

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