Assessment of Functional and Nonfunctional Distracter in an Item Analysis

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ABSTRACT

Introduction: Item analysis examines the student responses to individual test items (MCQs) to assess the quality of those items and test as a whole. Study was aimed to evaluate the MCQs or items for assessment of functional (FD) and non-functional distracters (NFDs) and their relation with Difficulty index (DIF I) and Item discrimination index (DI).

Material and methods: This Study was done in Kalinga Institute of Medical Science, Bhubaneswar. Total 25 MCQs and 75 distracters of an internal examination of MBBS students were analyzed.

Results: Out of 75 distracters, 40 (53.4%) NFDs were present in 22 items. 12%, 32%, 40%, and 16% of items had DE of 100%, 66.6%, 33.3% and 0% respectively. Out of 6 ideal items, 5(83.3%) items had of DE 66.6% that means each item contained only one NFD.

Conclusion: The distracter analysis provides a measure of how well each of the incorrect response contributes to the quality of a multiple choice item. Therefore, any ideal item should assess for good DIF and DI and also the presence of functional distracters.

Keywords: item analysis, multiple choice questions, non-functional distracter

INTRODUCTION

The objectives of medical education are to assess the three 'domains' of students' particularly, cognitive, psychomotor and affective. With greater usage of the MCQs for this purpose, the necessities of item analysis for creating a viable question bank of MCQs has emerged as a prime importance.[1] However, one of the major concerns in the construction of test items is to assure the reliability of the test items. The item analysis can help to determine those items that are good and those that need modification or deletion from a question bank.[1] It is a valuable yet simple procedure that helps in providing information regarding the reliability and validity of a test.[2]

Difficulty index (DIF) is one of the key parameters of item analysis that describes the percentage of students who correctly answered a given test item.[3] It ranges from 0 to 100%.The item discrimination index (DI) is the ability of an item to differentiate between students of higher and lower abilities and ranges between 0 and 1.[4] But the most important element of an item analysis is distracter effectiveness (DE), as it shows a relationship between the total test score and the distractors chosen by the student.[5] A MCQ is composed of a stem and several options. The correct option is called as the key while the incorrect alternatives are called as the distracter.[6] Non functional distracter (NFD) in an item is the option, other than the correct option selected by less than 5% of students and the functional or effective distractors is the option selected by 5%or more.[7] On the basis of number of the NFDs in an item, DE ranges from 0 to 100%. If an item contains three or two or one or nil NFDs then (DE) would be 0, 33.3%, 66.6% and 100% respectively.[8]

Despite the fact that preparation of a good item with effective distracter is very much essential to produce a valid MCQ hardly any attempt has been devoted carefully to examine the contents of a test. Many studies have been conducted on the quality of MCQs and item-writing flaws.[9] However, studies with the relationship between NFDs and other parameters of item analysis are scarce. Therefore this study was done with an objective to evaluate the MCQs or items for assessment of the functional and nonfunctional distracter and also their distracter efficiency to find how 'ideal questions' can be affected by non-functioning distractors.

MATERIAL AND METHODS

This Study was conducted in Kalinga Institute of Medical Science, Bhubaneswar, after taking proper informed consent from each student. An internal examination in the department of Paediatric was conducted in January 2016 which was attended by 76 out of 100 students. We have taken these 76 sample data by convenience sampling method as agree to participate of students as inclusion criteria and refused to give consent and absent on that day as our exclusion criteria. The test comprised of 25 "Best response type" MCQs with 75 distracters. All MCQs collected from guide book, text book and pears had single stem with four options including, one being correct answer and other three incorrect alternatives. To avoid possible copying from neighbouring student two invigilators were appointed with front and back camera in the examination room with a minimum distance of 2 feet between two students ahead, back and sideways.

The score of 76 students was entered in descending order and the group was divided into three. Group of students consisting of higher marks was considered as the higher ability (H) and the other group consisting of lower marks was considered as the lower ability (L) group. Out of 76 students, 25 were in H group and 25 were in L group; rests (26) were in the middle group and not considered in the study.

Based on these difficult index (DIF I), discrimination index (DI), Distracter effectiveness (DE) were calculated. DIF I was calculated as P= (H+L/N)*100, where P was the item difficulty index, H was the number of students in the higher ability group, L

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How to cite this article: Surya Kumar Namdeo, Sushil Dev Rout. Assessment of functional and nonfunctional distracter in an item analysis. International Journal of Contemporary Medical Research 2016;3(7):1891-1893.

was the number of students in the lower ability group and N was the total number of students. An item was considered difficult when the difficulty index value was less than 30%, considered easy when the index was more than 70% and acceptable when the value was 30-70%.[7] The item discrimination index (DI) was calculated using the formula d= (H-L/N)*2. Items with a discrimination index between 0.25-0.35 were considered good; more than 0.35 were excellent, between 0.20-0.24 were acceptable and below 0.20 were poor.[7]

STATISTICAL ANALYSIS

Data obtained was entered in MS Excel 2007 and analyzed. To find the Relation of ideal items (N=6) with both good to excellent, DI and DIF with their DE, we had calculated mean, standard deviation, standard error of mean. Test for statistical significance was done by applying unpaired student T test.

RESULTS

Total 25 MCQs and 75 distracters were analyzed. Out of 75 distracters, 40 (53.4%) NFDs were present in 22 items. 3(12%) items had no NFDs while 8(32%), 10(40%), and 4 (16%) items contained 1, 2, and 3 NFDs respectively (Table-1).

Out of 25 items, one had "good to excellent" level of difficulty (DIF I = 50 -60%) while only 7 items (28%) were within the range of acceptable DIF I (DIF I = 30 -70%) and 17 (68%) items which were either too easy or too difficult (Table-2). 17 items (68%) had "good to excellent" discrimination power (DI ≥ 0.35) while 8 items (32%) were poor DI (Table-3). When the items that contained both the good to excellent DIF and DI, there were only 6 items that recommended as ideal. Out of these six, five (83.3%) items had DE of 66.6% that means each item contained only one NFD. Relation of these ideal items with the DE showed an excellent level of statistical significant *P*<0.0001(Table-4).

DISCUSSION

DIF I of 15(60%), 2(8%), 8(32%)items in our study were very easy (p>70%), very difficult (p< 30%) and acceptable (p 30-70%) respectively. A study by Karelia B et al, showed 24 % items (p>70%), 15 % items (p< 30%) and 61% items were in acceptable range (p 30-70%) that was also supported by many researcher.[1,2,4,8] Discrimination index (DI) found in this study with > 0.35 were 12(48%), DI between 0.2 and 0.34 were 5(20%) and DI <0.2 were 8(32%) items. The Study done by Singh J P showed, the items with DI > 0.35 were 10(50%), DI between 0.2 and 0.34 were 4(20%) and DI <0.2 were 6(30%) items.[2] Another study done by Mehta G, also showed the Items with DI > 0.35 were 26(52%), DI between 0.2 and 0.34 were 9(18%) and DI <0.2 were 15(30%).[8]

The difficulty of a distracter is depending on its attractiveness of given population of individuals. Easy distracters can be discarded by almost all examinees. On the other hand difficult distracters have high effectiveness and response frequency. Designing of plausible distracters and reducing the NFDs is important aspect for framing quality MCQs.[10] In Our study among 75 distracters, 40 (53.4%) NFDs and 35(46.4%) FDs were present. Gyata Mehta et al concluded in her study that 53(35.3%) were NFDs, 38(18.6%) were FDs and 69(46.01%) distractors had nil response while Virendra et al found24% items were NFD and 76% items were with functional distracters out of 300 distracters.[8,11] As per Gajjar S et al non-functional distractors (NFD) were only 11.4% in their study. They also quoted that Poor DI (< 0.15) with negative DI was in 10 items and 15 items had 17 NFDs while rest items did not have any NFD with mean DE of 100%.[4]

12% of the all the distracters present in 3 items were sufficiently attractive to be selected whereas 8, 10,4 items had one, two and three nonelected distracters respectively that means zero, 1, 2, and 3 no of NFDs were present in 12%, 32%,40%,16% of items with DE of 100%, 66.6%, 33.3% and 0% respectively. In another study done by Sharif et al showed 34.6 %, 38.1%, 15.3% of items had one, two and three NFDs respectively, whereas 12% items had no NFDs as similar to our study.[12] Another study had shown that items with DE 66.6% were 18(54.4%), items with DE 33.3% were 9(27.27%) and items with DE as 0 were 6(18.18).[8] Gajjar et al have shown the Items with NFDs were 15(30%) out of which 13items had DE of 66.6% and 2items had DE of

Number of items with NFD	Frequency	Percentage	Cumulative	DE (%)
0 NFD	3	12%	12 %	100%
1 NFD	8	32%	44 %	66.6%
2 NFD	10	40%	84%	33.3%
3 NFD	4	16%	100%	0%

Table-1: Frequency distribution of Non functional distracters (NFDs) according to selection

Difficult index	Number of items with percentage	Mean	Interpretation	DE (%)
50-60%	1 (4%)	50	Good to excellent	66.6
30-70%	7 (28%)	58	Acceptable	71.38
>70%	15 (60%)	82.4	Too easy, Require modification	31.08
<30%	2 (8%)	13.01	Too difficult, Require modification	66.65

Table-2: Difficult Index of items and their relationship with Distracter effectiveness.

Discriminating index	Number of items with percentage	Mean	Interpretation	DE (%)
>0.35	12 (48%)	0.53	Excellent	52.72
0.34-0.25	3 (12%)	0.3	Good	44.4
0.24-0.20	2 (8%)	0.24	Acceptable	16.65
<0.20	8 (32%)	0.07	Require modification	45.82

Table-3: Discrimination index of item and their relationship with Distracter effectiveness

Statistics	DI	DE
Mean	0.6233	61.0500
SD	0.1268	13.5947
SEM	0.0517	5.5500
N	6	6
Unpaired t test	t = 10.8872 (standard error of difference = 5.550)	Extremely statistically significant (two-tailed P < 0.0001)

Table-4: Relation of ideal items (N=6) with both good to excellent DI and DIF with their DE

33.33%.[4] Students' performance depends on how distractors are designed. Analysis of the distractors identifies their errors so that they may be revised, replaced or removed. Based upon these indicators of item analysis an ideal item (MCQ) was the one which has good DIF I (30- 70%), high DI ≥ 0.25 and maximum DE (100%) with three functional distractors.[12] There were 6(24%) items as ideal in our study as similar to Gyata et al 12(24%).[8]

To know the relationship of DIF I and DI in the selected 6 ideal items with the number of NFD and DE, Mean±SD of DI and DE were 0.6233±0.1268 and 13.5947±5.5500 respectively and the data was statistically significant. Gajjar S et al also conducted the test for statistical significant upon DIF I and DE and concluded the result as significant.[4] That mean an ideal item usually contain a good number of FD besides excellent DIF I and DI.

Limitation of the study

We calculate item analysis in only 25 items of a single examination. The results will be more generalised if the sample will more and of the examination conducted over years.

CONCLUSION

The item analysis is an important phase in the development of an exam. However, neither the item difficulty nor the discrimination index considers the performance of the incorrect response options. So any ideal item should not assessfor only good DIF and DI but also the presence of functional distracters. The distracter analysis provides a measure of how well each of the incorrect options contributes to the quality of a multiple choice itemso that decisions can then be made about the item changes that are needed or even items that ought to be dropped from the exam.

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Source of Support: Nil; **Conflict of Interest:** None

Submitted: 13-05-2016; **Published online**: 14-06-2016