

Original article

Subjective versus objective item analysis of Multiple Choice Questions

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Abstract

Background: The science of medical education recommends validation of Multiple Choice Questions (MCQs) framed by teachers by a procedure called objective item analysis. Many medical college teachers however do not adopt this procedure and use their subjective judgment and expertise to validate MCQs. Wide variation between the subjective and objective analysis of MCQs may reduce the validity of such an assessment based on subjectively validated MCQs.

Aims and objectives: This study was undertaken to assess the degree of agreement between subjective and objective MCQ validation with regards to three parameters - difficulty index, discrimination index and distracter effectiveness.

Materials and methods: Five teachers from different departments were explained about these parameters and the cut off values used to categorize MCQs into groups based on these parameters. These teachers categorized 20 MCQs and 60 distracters each (total 100 MCQs and 150 distracters) into groups using their subjective judgment and expertise followed by an objective categorization of the same MCQs by the authors using the objective item analysis procedure. The degree of agreement between subjective and objective item analysis was expressed as sensitivity value of the subjective item analysis with objective item analysis as the gold standard.

Results: Data analysis revealed that there was wide variation in sensitivity values between teachers and maximum sensitivity value reached was 70% for all three parameters.

Conclusion: There is variable and relatively low sensitivity of subjective item analysis procedure and hence the objective analysis procedure must be used to determine the difficulty index, discrimination index and distracter effectiveness of MCQs.

Key words: MCQs, difficulty index, discrimination index, distracter effectiveness.

Introduction

Multiple choice questions (MCQs) are an important tool in formative and summative assessment. MCQs impart objectivity and reliability to assessment but may lack validity due to the possibility of the student answering the question correctly 'by chance'.⁽¹⁾ This possibility increases if there is no negative marking for an incorrect answer. Hence it is important to

ensure the validity of MCQs while using them as an assessment tool.

Traditionally MCQs have been framed and validated by teachers based on their subjective experience and expertise. These questions were stored (banked) and repeatedly used for various examinations. With advancements in Medical Education concepts, more objective methods of validation of MCQs based on checklists and calculation of various indices have

evolved. It is desirable that an objective method wherever available should be preferably used. The authors during their interactions with professional colleagues noted that many medical college teachers continued to use their subjective judgment to frame and validate MCQs for examinations. If the subjective judgment of teachers differs from the objective method the quality of assessment is likely to be hampered.

The aim of this study was to quantify the degree of agreement between the subjective and objective methods by determining the sensitivity of the subjective method using the objective method as the gold standard. The study focused on three parameters viz. The Difficulty Index, the Discrimination Index

and the Distracter effectiveness which are calculated during post-validation of MCQs.

Materials and Methods

The study was carried out in a medical college in the city of Mumbai. Approval for conducting the study was obtained from the institutional ethics committee. Five teachers from different departments consented to participate in the project. Every teacher was explained about the details of difficulty index, discrimination index and distracter effectiveness including the definitions of these parameters, the formulae used for their calculation, their cut off values for categorization and the meaning of these cut off values. These facts are summarized in Table 1.⁽¹⁾

Table 1: Details of difficulty index, discrimination index and distracter effectiveness.

Parameter	Formula for calculation	Categories and cut offs	Meaning of the categories
Difficulty Index	$\frac{(H+L)}{T} \times 100$	Difficult: Difficulty index less than 30%	Less than 30 % of students could answer the question correctly
		Medium: Difficulty index 30% to 70% ::	Between 30% and 70% of students could answer the question correctly
		Easy: Difficulty index above 70%:	More than 70% of the students could answer the question correctly.
Discrimination Index	$\frac{(H-L)}{T} \times 2$	Good discriminator: Discrimination index more than or equal to 0.2	H is at least 10% more than L
		Poor Discriminator: Discrimination index less than 0.2	H does not exceed L by more than 10%
Distractor effectiveness	Percentage of students having	Functional Distracter: Distracter effectiveness	At least 5% of students have marked the distractor as the right answer.

	marked that distractor as the right answer	more than or equal to 5% Non functional Distracter: Distracter effectiveness less than 5%:	Less than 5% of students have marked the distracter as the right answer.
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H: Number of High achievers who have answered the question correctly

L: Number of Low achievers who have answered the question correctly

T: Total number of students considered for analysis

Each teacher was asked to categorize twenty MCQs and respective sixty distracters using his/her own subjective judgment into groups using cutoffs as mentioned in table. All MCQs were of the single best response type with four options one being correct and the other three being distracters. There was no negative marking for an incorrect answer. Thus a total of one hundred MCQs and three hundred distracters were categorized subjectively by the teachers. This method of MCQ analysis and classification was named as subjective item analysis as it was based on the subjective judgment of teachers. These MCQs were those that were administered to the students during examinations held in the past.

The same MCQs were then analyzed based on answer sheets of students using the formulae mentioned in table 1 and values of difficulty index,

discrimination index and distracter effectiveness were calculated for each MCQ and distracter. Each test was attempted by fifty students (T=50) and after arranging the students in their descending order of marks the upper seventeen formed the high achiever group (H) and the lower seventeen formed the low achiever group (L). These calculations were done using the popular spread sheet software, Microsoft Excel. Using these values the MCQs and distracters were categorized into groups using cutoffs mentioned in table 1. This method of MCQ analysis and classification was named as objective item analysis as it was based on objective mathematical calculations and did not rely on subjective judgment of teachers. Considering objective item analysis as the gold standard the sensitivity of subjective item analysis was calculated for each of the three parameters from the following formula.

Number of MCQs/distracters correctly categorized subjectively by faculty members X100

Total number of MCQs / distracter categorized objectively

The sensitivity value indicated the percentage of MCQs in which the subjective analysis by teachers matched with the objective analysis (gold standard).

Results

The results of the study are summarized in figure 1, figure 2 and figure 3. The sensitivity of subjective item analysis for difficulty index ranged from 35% to 70% (figure 1), that of discrimination index ranged

from 45% to 70% (figure 2) and of distracter effectiveness ranged from 40% to 70% (figure 3) for the five faculty members who participated in the study.

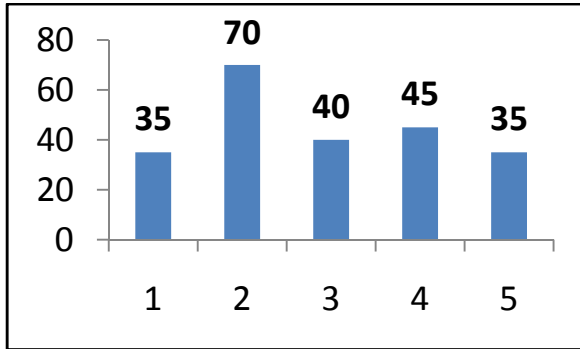


Figure 1: Chart for difficulty index showing faculty number on the X axis and the percentage sensitivity on the Y axis.

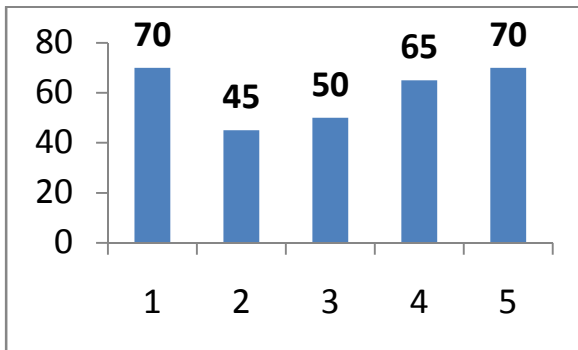


Figure 2: Chart for discrimination index showing faculty number on the X axis and the percentage sensitivity on the Y axis.

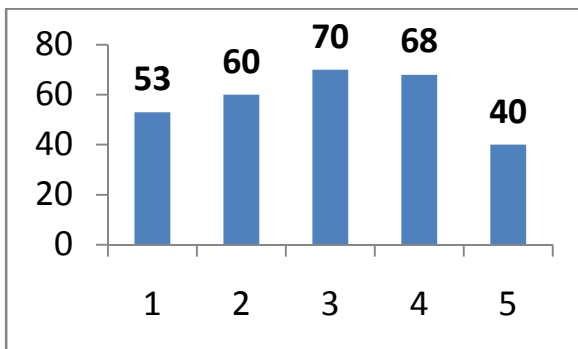


Figure 3: Chart for distracter effectiveness showing faculty number on the X axis and the percentage sensitivity on the Y axis.

Discussion

The present study was carried out to assess the sensitivity of the subjective item analysis of MCQs using objective item analysis as the gold standard for difficulty index, discrimination index and distracter effectiveness. Results showed sensitivity values of less than or equal to 70% for all three parameters. Also, there was a wide variation in sensitivity values obtained for different teachers. This emphasizes the fact that objective item analysis cannot be substituted by subjective method as it would lead to inappropriate MCQs being banked and used in the examinations reducing the validity of assessment.

To the best of our knowledge this is the first study of its kind conducted with the aforesaid objective. However various studies have been conducted to determine what percentage of MCQs set subjectively by teachers and used in examinations conformed to standard guidelines for difficulty index, discrimination index and distracter effectiveness after performing objective item analysis. A few are mentioned below.

Gajjar S. et al conducted an objective item analysis of 50 MCQs and reported that 48% MCQs had the acceptable difficulty index, 48% of MCQs had acceptable discrimination index and 89% of the distracters were functional.^[2] A similar study conducted by Karkal YR et al using 488 MCQs showed that 56% of MCQs had acceptable Difficulty index and 56% of MCQs had acceptable discrimination index. The parameter of distracter effectiveness was not assessed by these researchers.^[3]

Mehta G et al in their study involving 50 MCQs reported that 62% of MCQs had an acceptable difficulty index, 70% of MCQs had acceptable discrimination index and only 18% of the distracters were functional.^[4] In a study comprising 50 MCQs,

the figures reported by Kaur M et al for percentage of acceptable MCQs based on difficulty index and discrimination index were 76% and 86% respectively while 82% of their distracters were functional.^[5]

The above studies reiterate the importance of performing objective item analysis of MCQs to assess their quality and banking and using only those that conform to standard guidelines. However, as stated earlier many medical college teachers continue to use MCQs framed by them based on their subjective judgment without performing objective item analysis. Finding out the reasons for this was not in the scope of this study. However, the authors perceive the following reasons why objective item analysis may not be performed by teachers.

- 1) There may be lack of awareness regarding objective item analysis.
- 2) There may be no compulsion from the authorities to use the objective method.
- 3) The objective method may be time consuming and laborious as compared to the subjective method specially if done manually.
- 4) Teachers may feel that due to their experience and expertise their subjective judgment is as good as an objective validation. A further study needs to be undertaken to test the reasons mentioned above.

The following could be cited as the limitations of the study. The observation that faculty members may not be performing objective item analysis may be limited and cannot be generalized as no specific study is carried out to ascertain the prevalence of this phenomenon.

Conclusion:

There is a low and variable sensitivity of subjective item analysis procedure and medical college teachers

must undertake the objective item analysis procedure irrespective of their seniority and expertise to validate MCQs.

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