EFFECT OF NON-FUNCTIONING DISTRACTORS ON DIFFICULTY INDEX OF MULTIPLE CHOICE QUESTIONS FOR FORMATIVE ASSESSMENT OF STUDENTS AT REHMAN MEDICAL COLLEGE, PESHAWAR PAKISTAN

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ABSTRACT

Introduction: Construction of proper MCQs form the basis of effective assessment. Strong distractors help to increase the value of the MCQ; hence the presence of Non-Functional Distractors (NFD) reduces the assessment potential of such questions. The present study was conducted to determine the effect of Non-Functioning distractors on Difficulty Index based on a Physiology MCQ internal assessment of 1st Professional MBBS class of Rehman Medical College (RMC), Peshawar, Khyber Pakhtunkhwa, Pakistan.

Materials & Methods: The descriptive study was conducted in November 2015 on the Physiology Theory Test performance of 100 First Professional MBBS students of RMC, Peshawar. The study included 50 one-best type MCQs; these were marked manually based on the keys provided and analyzed by MS Excel 2013. Students were categorized by top and bottom 27%; Difficulty Index (P) was calculated, Distractor analysis was done, and NFDs were identified. NFD and P were correlated by Pearson's *r*, using SPSS 15.0, keeping $p \leq 0.05$ as significant.

Results: Out of the 50 MCQs, 58% were of average difficulty, 22% were difficult, and 20% were easy; 26% MCQs had 0 NFDs, 20% had 01 NFDs, 38% had 02 NFDs, 14% had 03 NFDs and 2% MCQs had 04 NFDs. The Easy MCQs had 3 NFD in 60% items, the Average MCQs had 2 NFDs in 45% items, and the Difficult MCQs had 0 NFDs in 45% items. Pearson's *r* showed significant positive correlation between NFDs and P ($r=0.576$, $p<0.001$, $r^2=0.333$).

Conclusion: Non-Functioning Distractors had a significant effect on the Difficulty Index of MCQs and can be factors determining overall examination performance of students.

Keywords: Education, Medical, Undergraduate; Item Analysis; Distractor Analysis; Knowledge; Learning.

INTRODUCTION

Multiple Choice Questions (MCQs) are widely recognized in medical education and utilized as instruments for assessing the knowledge competency of medical students. The MCQ format permits instructors to evaluate large numbers of candidates efficiently and to test a wide range of content.[1,2] MCQs are marked objectively. In present times, a machine, the Optical Mark Recognition (OMR) device, is utilized for marking that has made marking simple and time efficient.

The MCQ, technically called an Item, consists of two main parts: a) the stem that presents a problem, situation or statement and b) the options, depicting possible solutions to the problem. The options (alternatives) include the one-best-correct answer called the Key and several plausible but incorrect answers, referred to as Distractors. The objective of MCQs assessment is achieved only if the construction of MCQ is done appropriately.

Constructing a good MCQ is a complex, challenging and time-consuming process. Item analysis techniques are used to check the quality of an MCQ, a process that examines students' responses to individual test items.[3,4] In item analysis, Difficulty Index (symbolized by p) describes the difficulty level of an MCQ, Discrimination Index distinguishes between high & low scoring students and Distractor Efficiency elucidate the effectiveness of MCQ.[5] The quality of an item is dependent upon the functioning distractors.[6,7]

Research in medical education provides a real-time basis for improvements in the curriculum including its assessments. The present study was conducted to determine the correlation between Difficulty Index and Non-Functioning Distractors in Physiology MCQs test of 1st Professional MBBS class of Rehman Medical College, Peshawar, Khyber Pakhtunkhwa, Pakistan. The study will help to provide feedback to the examiners and the Department of Medical Education regarding the proper formatting and quality of MCQs prepared for the examination question bank.

OBJECTIVES:

- To classify the test items of Physiology End of Term examination of First Professional MBBS based on the proportion of Non-Functioning distractors.

- To determine the correlation between the number of Non-functioning Distractors in an item and its Difficulty index.

MATERIALS & METHODS

This study was conducted in November 2015 at Rehman Medical College Peshawar on the theory MCQs paper of Physiology MBBS 1st Professional conducted in July 2012 on 100 medical students; the duration of the examination was 50 minutes. The paper comprised of 50 MCQs of the One-Best type (having five options including key and four distractors). For each correct option 01 mark was awarded with no negative marking, making a final test score of 50. After manual marking of 100 MCQs papers, data were entered in MS Excel. Scores were arranged in descending order; top 27 were taken as high achievers and bottom 27 as low achievers. Students who had not answered all the MCQs were excluded from both groups.

The difficulty index was calculated by using the formula given below:

Difficulty index (P) = (H+L)/N*100

Where N is the number of students in the high and low groups (54), H and L are the number of correct responses in high and low group respectively. Based on the value of the difficulty index, the MCQs were then categorized as Easy (>70%), Average (30%-70%) and Difficult (<30%).[8] Distractors selected by less than 5% of students were considered Nonfunctioning distractors.[3,8-10]

Data Analysis:

The MCQs of the high and low group students were subjected to Distractor analysis; frequencies and proportions of the NFD were obtained for all the 50 items. Difficulty Index was calculated based on the standard formula. Classification of the items was done for Difficulty Levels. Pearson's Correlation was performed between Difficulty index and Non-functioning distractors using SPSS 15. A p ≤ 0.05 was considered statistically significant.

RESULTS

The cutoff scores for the high achievers were between 28-40 marks; for the low achievers, these values were 16-23 marks (Table 1).

Table 1: Categorization of students based on achievement (n=56).

#	Student Categories	Number (%)
1.	**Top 27 (marks)**	
	35-40	07 (25.9)
	28-34	20 (74.1)
2.	**Bottom 27 (marks)**	
	16-19	12 (44.4)
	20-23	15 (55.6)

Figure 1 shows out of a total of 50 MCQs difficulty indices of 20% were easy, while 22% were difficult and the remaining 58% of the items were average difficult.
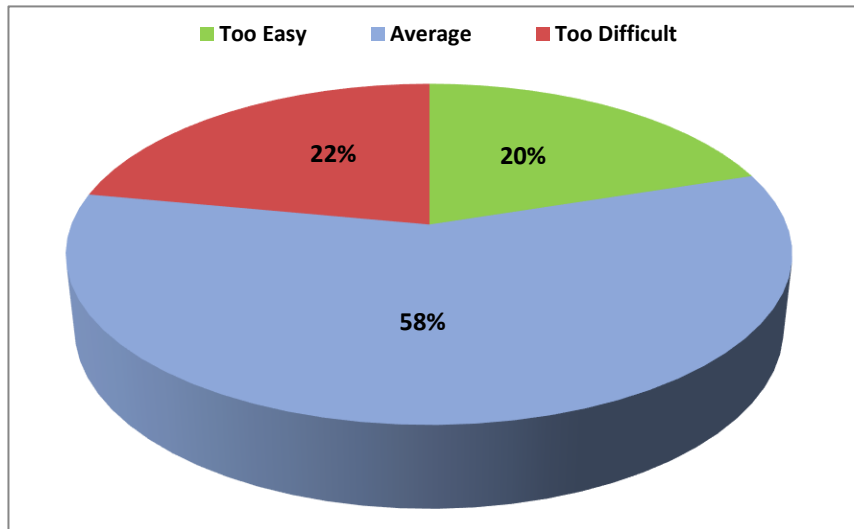

Figure 1: Pie chart of the distribution of Difficulty Level of MCQs

Figure 2 shows that out of 50 items 26% MCQs were with 0 NFDs, 20% were with 01 NFDs, 38% were with 02 NFDs, 14% were with 03 NFDs and only 2% MCQs were with 04 NFDs.
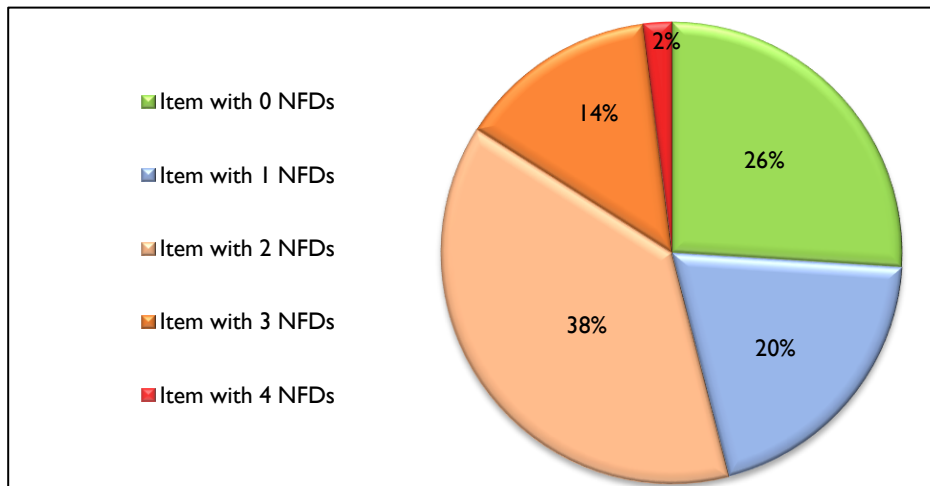

Figure 2: Distribution of MCQs based on the number of Non-Functioning Distractors

Figure 3 shows the relationship between the No of Non-Functioning distractors and difficulty level, it is seen that MCQs which have more Non-Functioning distractors are easier. It means when the number of Non-Functioning distractors increases the easiness of the MCQs also increases. In our study it is seen that the MCQs which have at most 2 NFDs are average difficult.
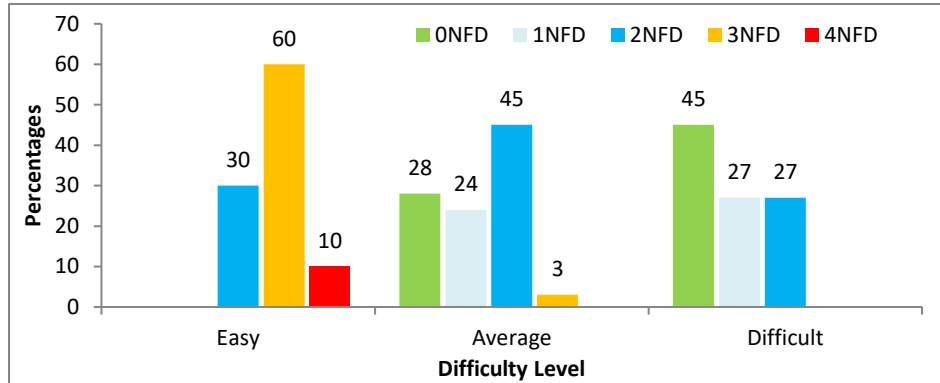

Figure 3: Bar graph of distribution of Non-functioning Distractors by Difficulty levels.

Figure 4 shows Pearson's correlation between the difficulty index and the number of Non-Functioning distractors for the 50 MCQs. It was found highly significant. The value of r shows that there is strong correlation between the number of Non-Functioning Distractors and difficulty Index.
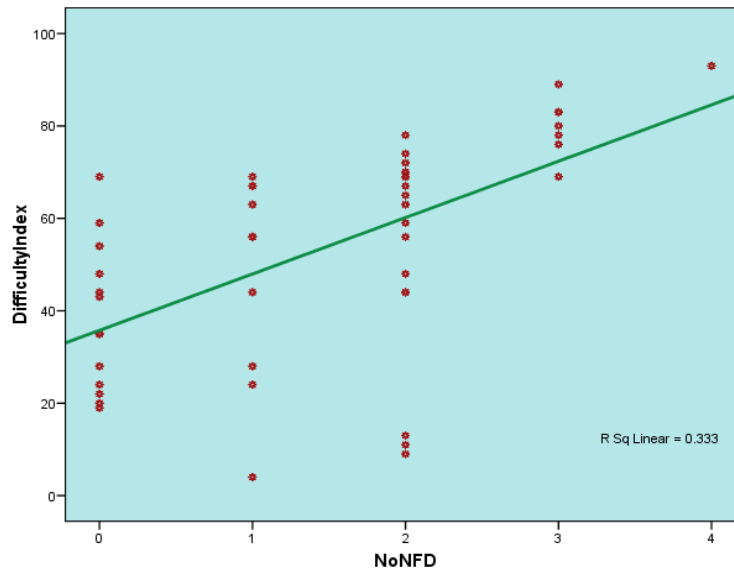

Figure 4: Scattergraph of Non-Functioning Distractors and the Difficulty Index showing a significant positive correlation (r = 0.576, p<0.001)

DISCUSSION

MCQs are reliable and commonly used tool for assessing the knowledge capabilities of students. The first multiple choice question (MCQ) was wrote by Frederick J. Kelly in 1914 in an attempt to improve standardization and simplify marking compared with assessment methods like short answer questions.[11] Designing good MCQs is a complex, challenging and time-consuming

process. MCQs need to be tested for the standard or quality.[4] Item analysis helps to evaluate the quality of Multiple Choice Question. It is the procedure of evaluating the performance of a Multiple-choice item after it has appeared in a question paper.[3] It is a measure of three important parameters of multiple choice item such as Difficulty index, Discrimination index and Functionality.[12]

The present study tried to find the correlation between Difficulty Index and number of Non-Functioning Distractors. A strong and significant correlation was seen between the number of Non-Functioning Distractors and Difficulty Index. This finding confirms the general understanding in the literature that Non-Functioning Distractors can affect the examination quality by decreasing the difficulty of the MCQs.

Abdulghani HA, et al (2014)[9] investigated the correlation between the number of Non-Functioning Distractors and the Difficulty Index of MCQs. The study concluded that MCQs which have more NFDs are easier.

A study by Tarrant M, et al (2009)[13] further identified that good MCQs contain at least three functioning distractors. Items with more than 2 NFD are easier and tend to reflect poor performance of teachers in selecting plausible and effective distractors. This conclusion is also supported by another study by Rodriguez MC, (2005) who advocates at least three functional distractors.[7]

Suruchi & Rana SS, (2014)[14] investigated the relationship between Difficulty level and Discrimination level of test item in an achievement test in Biology. His result shows that item Discrimination power improved with the increase in difficulty value but got decreased for very easy and very difficult test items.

CONCLUSION

The number of Non-Functioning Distractors in an MCQ can affect the item quality by decreasing its difficulty level, thereby affecting the examination performance of students. A good MCQ should have at least three functioning distractors to be effective as assessment.

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