Original Article

Evaluation Of Discrimination Index Of Single Best Response Type Of Multiple Choice Questions In Physiology By Item Analysis

Dr Anupam Suhas Khare,[1] Dr Amita Verma,[2] Dr. Archana Akshay Kadam,[3] Dr. Kiran Avachar.*[4]

[1] Associate Professor, Department of Physiology, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik.
[2] Assistant Professor, Department of Physiology, Dr. DY Patil Medical College & Hospital, Nerul, Navi Mumbai.
[3] Associate Professor, Department of Physiology, Dr.DY Patil Medical College & Hospital, Nerul, Navi Mumbai.
[*4] Assistant Professor, Department of Physiology, Dr. Vasantrao Pawar Medical College, Hospital and Research Centre, Nashik.
Corresponding Author: Dr. Kiran Avachar*
Email id: drkiran122@gmail.com
Address for correspondence: Department of Physiology
Dr. Vasantrao Pawar Medical College,
Hospital and Research Centre, Nashik
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Abstract

Introduction: The most reliable format of objective evaluation is multiple choice questions (MCQs) which ideally should be drawn from a question bank of valid and tested MCQs. Discrimination index is one of the most important tool to assess the quality and validity of a MCQ/Item. An item should be able to discriminate between those students with high tests scores and those with low ones. Higher the discrimination index of an item, better is the ability of the item to discriminate between students with high tests scores and those with low ones**.**

Objectives: The objectives of the study were to find out discrimination index for each item in a physiology MCQ test paper.

Materials and methods: Physiology MCQ test paper comprising of 40 items, with answer key and answer papers of 198 first MBBS students were obtained. Choice marked for each item by each student and his scores were entered in Microsoft Excel. Students were ranked & top 1/3rd and bottom 1/3rd were chosen as high achiever and low achiever group respectively. Discrimination index for each item was determined using appropriate formula.

Results: 2 items had acceptable discrimination index, 13 items had good discrimination index,
10 items had excellent discrimination index. 15 items had poor discrimination index out of which
3 items had negative discrimination index.

Conclusion: Valid items with discrimination index more than 0.2 can be incorporated in item bank. Items with discrimination index less than 0.2 should be either revised or discarded. Discrimination index can detect flaws in test questions and is helpful in giving appropriate feedback to teachers and students.

Keywords: Discrimination index, Item analysis.

INTRODUCTION:

Objectivizing evaluation is becoming increasingly important in the field of education. The most popular and reliable format of which is multiple choice questions (MCQs). A single MCQ in a MCQ test paper is known as an item. The use of standardized achievement tests consisting of multiple-choice questions is widespread as they are practical and provides objective results especially for mega universities with large number of learners. [1,2]

Designing MCQs is a complex and time-consuming process in a multidisciplinary, integrated curriculum and such MCQs need to be tested for the standard or quality**.** [3]

An item should be capable of distinguishing between knowledgeable and ill-informed students. The discrimination index of an item is the ability of the item to distinguish between high scoring and low scoring students. In other words, index of discrimination is the ability of an item on the basis of which the discrimination can be made between the high achiever and the low achiever students. [1,4]

The aim of this study was to identify students' weaknesses in learning using discrimination Index (DI) and to propose improvements in teaching and learning for the specific areas to enable students to achieve the required level of knowledge and competencies. [5]

MATERIAL AND METHODS:

The present study was conducted in department of physiology of a government medical college after obtaining consent from the institutional ethics committee.

All first MBBS students who appeared in preliminary Physiology examination conducted were included while students absent for the examination were excluded from the present study.

It was observed that 2 students out of 200 did not appear for the examination.

MCQ test paper comprising of 40, single best response type of items, it's answer key and corrected answer papers of 198 first MBBS students were collected.

All the items in test paper were prevalidated by subject experts. The time allotted for the examination was 40 minutes. Each item had 4 options. Each correct answer was given half mark.

Option marked for each item by each student and his MCQ scores were entered in Microsoft Excel sheet. Students were then ranked in descending order of their scores. Top 1/3rd and bottom 1/3rd were chosen as high achiever group and low achiever group respectively. [6]

Thus responses of total 132 students **(T)** were assessed.

Frequency table for each item was prepared. For example

Table 1 – Frequency table for item number one

Options	No. selecting the option amongst high achievers **(H)**	No. selecting the option amongst low achievers **(L)**
a (Key)	**53**	**25**
b (Distractor)	1	9
c (Distractor)	5	8
d (Distractor)	7	24
No response (NR)	0	0
Total responses	66	66

Discrimination index for each item was calculated by noting correct responses for key in both

groups and by using the following formula -

Table 2- Formula for discrimination index [6, 7,8,9] &

Parameters	**Formula**
Discrimination index **(d)**	**[(H-L)x 2/T]**

Table No.3- Evaluation of discrimination index [7,8,10]

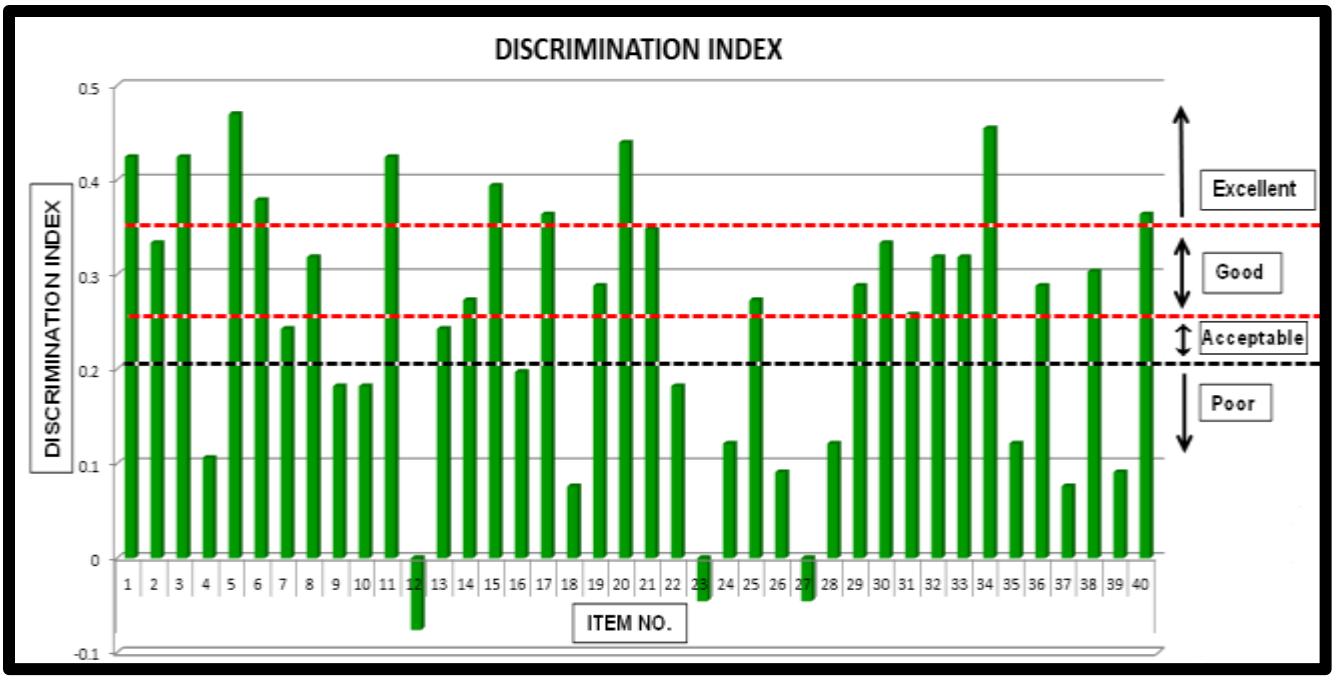
Discrimination index	**Interpretation**
0.2 to 0.25	Acceptable
Between 0.25 to 0.35	Good
More than 0.35	Excellent
Less than 0.2	Poor
Negative value	Poor- defective item

RESULTS:

Table 4- Discrimination index interpretation

Sr no	**Item Number**	**Discrimination index**	**Total items**	**Interpretation**
1	7,13	0.2 to 0.25	2	Acceptable
2	2,8,14,19,21,25,29,30,31,32,33,3638	Between 0.25 to 0.35	13	Good
3	1,3,5,6,11,15,17,20,34,40	More than 0.35	10	Excellent
4	4,9,10,16,18,22,24,26,28,35,37,39	Less than 0.2	12	Poor
5	12,23,27	Negative value	3	Poor-defective items

Graph 1- Demonstrates discrimination index of all items and its interpretation



DISCUSSION:

It is clear that thoughtfully written MCQ items can serve to assess higher level cognitive processes, although creating such items does require more skill than writing memory based items.[11,12] One criticism is that the format of MCQ items lets students guess even when they have no subjective knowledge of the topic under consideration.[13]

Use of MCQ as testing method in medical curriculum is increasing. So it becomes very important that quality of questions be maintained too. [14, 15]

One way to examine the quality of MCQ items involves analyzing the responses that examinees make, and this is the approach used in the present study. An item should be able of discriminate between knowledgeable and ill-informed students.

The present study shows that discrimination index of 2 items was acceptable, 13 items was good, 10 items was excellent, 12 items was poor & 3 items had a negative 'd' value. [Table 4][Graph 1]

A research study done by Namdeo and Sahoo using 25 multiple choice questions administered to 76 medical students at Kalinga Institute of Medical Science (KIMS) Bhubaneswar revealed that discrimination index of 12 (48%) items was excellent (d value>0.35), 3 (12%) items were good (d value 0.20-0.34) and 8(32%) items were poor (d value<0.2%). [9]

Similar study was conducted in the Department of Pathology by Chandrika Rao in where 40 MCQs were administered to 120 2nd year MBBS students. It was found that discrimination index of 24 (60%) items was excellent, of 4 (10%) items was good, of 6 (15%) items was acceptable, and of 6 (15%) items was poor (d < 0 to 0.19). [16]

A research study carried out by Burud, Nagandla and Agarwal using 120 multiple choice questions administered to 113 medical students at International Medical University, Malaysia revealed that 35 (29.17%) items showed good discrimination, 37 (30.83%) items showed fair discrimination, 13 (10.83%) items showed poor discrimination and 10 (8. 34%) items showed negative discrimination.[17]

Items with 'd' < 0.2 must be revised or discarded. In the present study, the MCQ test paper had 15 such items (Item no. 4,9,10,12,16,18,22,23,24,26,27,28,35,37,39) of which item no. 12, 23 and 27 had a negative 'd' value. If the discrimination index of an item is poor, it could be because, the question was too easy or too difficult. In the present study, the MCQ test paper didn't contain ambiguous questions, the answer key was right, the correct answers didn't involve more than one response and there was no typographical error. Perhaps learning objectives of the teaching

learning session were not met far as item with 'd' < 0.2 are concerned. Students either did not understand or misunderstood what was taught.

Loon stated that by referring to the analysis of discrimination index, two hypotheses will be obtained namely; either the question is too hard even for the group of high achievers or the question is too easy that even the group of students with lower achievements are capable of answering them correctly.[5]

Anon noted that the value of discrimination index approaching +1.00 is good for the assessment of norm reference as it is capable of differentiating or discriminating the group of students of high and low achievements. Conversely, the value of discrimination index approaching negative is bad for the assessment of norm reference as it will wrongly interpret the outcomes, in which the numbers of low achievers who managed to answer correctly is higher than the group of high achievers. [5]

In the present study, 3 items had a negative 'd' value [Table 4][Graph 1]

Gajjar S (2014) [4] and Burud I (2019) [17] found items with negative discrimination index in their studies.

Items with negative discrimination index decrease the validity of the test and should be removed from the collection of questions. Easy items with poor discrimination index should be reviewed and reconstructed.[16]

In the present study, answer key of three items was "All of the above" which ideally should not be used. Hence even low achievers were drawn to that key as a result of which discrimination index of these items was below 0.2.

Conclusion:

Valid items with discrimination index more than 0.2 can be incorporated in item bank. Items with discrimination index less than 0.2 should be either revised or discarded.

Discrimination index of an item can help us: [5]

1) To identify the concepts that need to be taught again, if most of the students with high achievements are not able to answer correctly,
2) To identify the strength and weaknesses of parts of the curriculum, which can and cannot be dominated by the students,
3) To provide feedback to students with high achievements regarding their strengths and weaknesses on the topics assessed,
4) To identify the content bias questions, such as the topics that are not taught in class,
5) To guide students with high achievements to pursue their studies in a specific area.

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