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Qualitative analysis of multiple choice questions in Department of Anatomy

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Abstract

Introduction: Multiple choice questions are the most frequently used assessment methods in the Medical colleges. It can be used for assessment of higher levels of cognitive domain, if constructed properly. Each MCQ or item is made up of a stem and incorrect responses or distracters. **Objective:**Main objective of this study is to analyze items given in formative assessment of the Anatomy department using different statistical indices.**Methodology:**fifty multiple choice questions from 5 PCTs of 150 students of 2017-18 batch were selected using systematic random sampling for the same. Items were analysed using the formulae and microsoft excel. **Result**:In the present study, total 30 items are found to be ideal with acceptable difficulty index, acceptable discrimination index &atleast 66% distractor effectiveness.Weak positive correlation is found between difficulty index & discrimination index. Out of total 150 distracters, 13 distracters are found to be non-functional, 8 items with 1 nonfunctional distractor (NFD), 1 item with 2 NFD & 1 item with 3 NFDs have been observed. **Conclusion:**Ideal items are preserved for the departmental question bank for future use and items with some flaws are rectified and those with no possible corrections are discarded.
Keywords: anatomy,department

Introduction

Assessment needs to be continuous & more frequent for undergraduate students in medical colleges. Multiple choice questions are usually included as one of the method of assessment. Item analysis is an important tool to assess & increase the effectiveness of the multiple choice questions as assessment method for the undergraduate students. Each item's contribution in the test is analyzed. It is important that each item is correctly framed as; it is used for testing the concept, idea or objectives achieved by the students. Item analysis examines student's responses to individual test items to assess the quality of those items or test as a whole[1].

Item analysis is a post validation procedure that characterizes every MCQ and its distracters by assigning a numerical value to it in the form of a difficulty index, a discrimination index and distracter efficiency[2].

Different statistical methods like difficulty index, discrimination index and distracter effectiveness are used to assess the difficulty level of the MCQs, ability of MCQ to discriminate between high scorers & low scorers & identification of functional & nonfunctional distracters respectively.After item analysis of MCQs, ideal ones can be stored in the question bank of the department for its further use in future examinations. While MCQs in which some flaws are identified can be revised and analyzed subsequently. If flaws in the Certain MCQ can't be rectified, it can be discarded.

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Main objective of this study was to analyze the MCQs of the formative assessment held in the Anatomy department & to prepare a departmental question bank.
Aim: To analyze the quality of multiple choice questions of Part completion examinations of 2017- 18 batch in the Department of Anatomy.
Objectives:
- To calculate the Difficulty index of selected items of MCQ papers of 5 Part completion examinations of 2017- 18 batch.
- To calculate the Discrimination index of selected items of MCQ papers of 5 Part completion examinations of 2017- 18 batch.
- To correlate difficulty index and discrimination index of selected items in 5 MCQ papers of Part completion examinations of 2017- 18 batch.
- To calculate the distracter effectiveness of all the 150 distracters of 50 items of PCTs.
- To interpret the above findings.

Materials and Method
50 multiple choice questions from 5 PCTs of 2017-18 batch were selected using systematic random sampling (10 MCQs from each PCT). Each MCQ consisted of a stem, a key (correct answer) and 3 plausible distracters. Answer sheets of the students, who were present in the exam out of total 150 students of 1st MBBS batch 2017-18, were included in the study. Award sheet was prepared by arranging the marks of selected questions of respective PCT in descending order. Top 50 & bottom 50 students were grouped as high scoring & low scoring groups respectively in each PCT. Responses opted by each student for these items were tabulated. Each item was analyzed for difficulty index, discrimination index by using the formulae-

difficulty index$= (h+l)/n\times100.^3$ discrimination index$=(h-l)\times2/n.^3$

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Where, h= correct response selected by high scorers, l= correct response selected by low scorers, n=total number of students excluding non-responders.

Mean values & standard deviations of both the difficulty index and discrimination index were calculated using Microsoft Excel. Both these indices were correlated using Microsoft excel.

All 150 distracters were analyzed for the identification of number of nonfunctional distracter (NFDs). The distracters which were not opted by 5% of students, were considered as non- functional distracters. Distractereffectiveness is dependent on numbers of NFDs.All the indices are interpreted & MCQs are selected to be kept in future departmental question bank and other faulty MCQs are revised or discarded.

Observations and Results

**Table 1:showing values of item analysis parameters**

Item analysis parameters	Mean	Std deviation
Difficulty index (Diff I)	47.44	19.20
Discrimination index (DI)	0.34	0.166

Table 2:showing values of item analysis parameters of individual PCTs

	Abdo PCT	HNF PCT	Brain PCT	Thorax PCT	Supex PCT
Mean Diff I	41.11 ±12.98	37.76±14.29	42.56±23.32	51.73±20.68	64±12.75
Mean DI	0.283±0.08	0.34±0.15	0.32±0.17	0.30±0.20	0.47±0.14
Correlation between Diff I & DI	-0.22309	0.66981	0.708743	-0.02392	-0.41696
Mean Distractor effectiveness	90%	97%	97%	85%	86%
NFD	3	1	1	4	4

Scatter diagram showing Correlation between difficulty index & discrimination index of all PCTs.
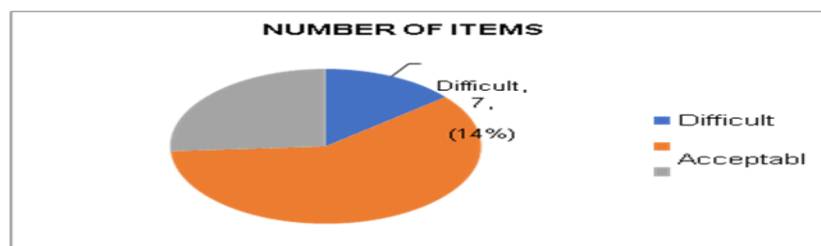Correlation coefficient is calculated as 0.347002
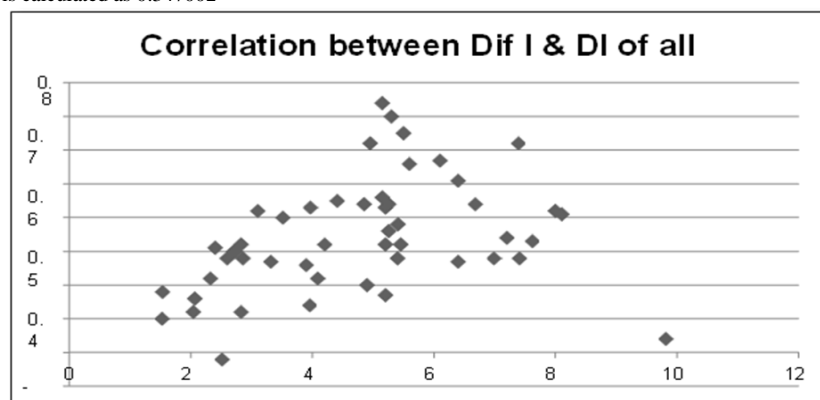
Fig 1: X axis –Difficulty index (Dif I) & Y axis- Discrimination index (DI)

Table 3:showing interpretation of difficulty index of items in present study

Difficulty Index	Number of Items	Interpretation	Action Taken
>70%	7	Difficult	Revise
30-70%	30	Acceptable	Include in question bank
<30%	13	Easy	Revise

Fig 2: Pie chart showing interpretation of difficulty index in present study

**Table 4: Interpretation of items of formative assessments according to Discrimination index**

DiscriminationIndex	Number ofItems	Interpretation	Action Taken
>0.4	19	Excellent	Include in Question Bank
0.2-0.29	11	Acceptable	Include in Question Bank
0.3- 0.39	11	Good	Include in Question Bank
0-0.19	8	Poor	Revise
Negative	1	Wrong	Revise

Table 5:Showing classification of nonfunctional distracters (NFDs) in individual PCT

	Items with 0 NFD(100%)	Items with 1 NFD(66%)	Items with 2 NFD(33.3%)	Items with 3 NFD(0%)
PCT abdo	8	1	1	0
PCT Brain	9	1	0	0
PCT HNF	9	1	0	0
PCT Supex	6	4	0	0
PCT Thorax	8	1	0	1
Total formative asessment	40	8	1	1

Table 6: Distractors of Multiple choice questions or items of whole formative assessment

Indicators	Values
Number of items	50
Distracters	150
Functional distracters	137
NFDs	13
Items with 1 NFD	8
Items with 2 NFDs	1
Items with 3 NFDs	1
Items with 0 NFD	40
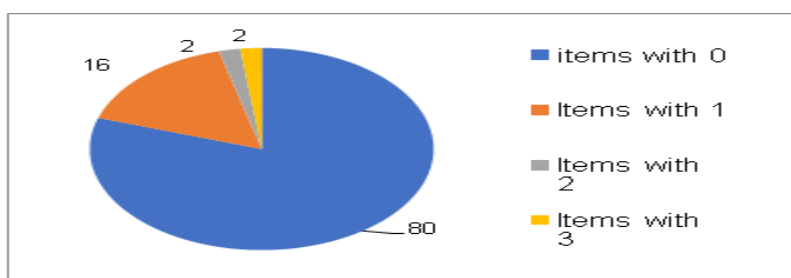
Fig 3:Pie chart showing status of NFDs in items or MCQs of PCTs

Items with acceptable diff I, acceptable discrimination index &atleast 66% distractor effectiveness are considered as ideal.

Table 7:Ideal items

PCTs	Ideal items
Thorax	7
Supex	8
HNF	5
Brain	4
Abdo	6
Total	30

Discussion:
Present study was planned to find out the effectiveness of MCQ question papers of internal examinations(PCTs) held in the Anatomy Department & to prepare a reliable MCQ question bank for the department. MCQ answer sheets of formative assessment or 5 Part completion tests of 150 students each were used for item analysis. For each PCT we calculated difficulty index, discrimination index & distractor effectiveness.Difficulty index is relevant for determining whether students have learned the concept being tested. Any MCQ test must begin with items with high FV. If the more difficult items are present at the start of the test, students can become upset early during an examination and which is likely to affect the student's overall performance in that particular examination. The difficulty indices of PCTs of abdo, HNF, brain, supex and thorax conducted in the department of Anatomy in the year 2017-18 are 41.11 ±12.98, 37.76±14.29, 42.56±23.32, 51.73±20.68 & 64±12.75 respectively. While, mean of difficulty index is calculated as 47.43 with standard dev of 19.20. Out of 50 items, 30 (60%) items are found to be acceptable, 7(14%) easy & 13(26%) as difficult.Item analysis when performed on 150 MBBS students by Patel and Mahajan for MCQ test with 50 questions, 10(20%) items were in unacceptable range (Diff I <30% or Diff I>70%) & 40 (80%) items were in acceptable range (Diff I=30-70%)[4].Kolte reported mean DIF I as 57.92 ± 19.58. In this study, the P value of 26 (65%) items was in acceptable range (30–70%), 10 (25%) items were easy ($P > 70\%$), and 4 (10%) items were difficult ($P < 30\%$)[5].Item analysis done by Mehta and Mokhasi on 100 MBBS students for MCQs test comprising 50 questions in the subject of anatomy reported mean DIF I of 63.06 ± 18.95 with DIF I of 31 (62%) items in the acceptable range ($P = 30$–70%), 16 (32%) items were too easy ($P > 70\%$), and 3 (6%) items were too difficult ($P < 30\%$)[6].In a study conducted by Patil and Patil on 100 MBBS students of medicine for 100 MCQs, mean DIF I of 48.90 ± 13.72 was reported. In this study, the Dif I of 35 (22%) items was in the acceptable range (30–70%), 25 (25%) items were ideal (50–60%), 18 (18%) items were too easy ($P > 70\%$), and 22 (35%) items were too difficult ($P < 30\%$)[7].Hence, value of mean difficulty index of present study is very close to that of study by Patil and Patil. Acceptable range of difficulty index is in accordance with the study done by Kolte and Mehta.Discrimination index indicates the ability of a question to discriminate between a skilled and

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unskilled student. In present study, we calculated discrimination indices for individual PCTs. Their mean values are 0.283±0.08, 0.34±0.15, 0.32±0.17, 0.30±0.20 & 0.47±0.14 for PCTs of abdo,HNF,brain, supex& thorax respectively. While, mean of discrimination index for all PCTs is 0.343 with standard dev of 0.167. Based on discrimination index calculation, 19 (38%) items are found excellent in discrimination, 11(22%) are good and 11(22%) are acceptable, and 8(16%) poor, 1(2%) item out of 50 is found to have negative discrimination index. Negative discrimination index can be because of wrong key, ambiguous framing of questions[8].In an item analysis study by Patil and Patil, out of total 100 items, 24 had DI < 0.2 (poor), 45 had DI ≥ 0.20 and ≤ 0.35 (good), and 31 had DI > 0.35 (excellent)[7].In another study by Patel and Mahajan on item analysis of 50 items, 9 items had DI < 0.2, 21 items had DI ≥ 0.20, and d≤ 0.35 and 20 items had DI > 0.35[4].In a study by Mehta and Mokhasi on item analysis, mean DI was 0.33 ± 0.18. Out of total 50 items, 15 (30%) items had DI < 0.2, 9 (18%) items was DI ≥ 0.20 and ≤ 0.35, and 26 (52%) items had DI > 0.35.[6] Mean discrimination index value of present study corresponds with the study done by Mehta G and Mokhasi V.Mehta G revealed that 62% and 70% of MCQs were in the acceptable range of difficulty index and discrimination index respectively[6].Namdeo SK et al performed an item analysis of 25 MCQs in pediatrics and reported that 60% and 68% of MCQs were acceptable based on difficulty index and discrimination index respectively[9].In present study discrimination index correlated poorly with difficulty index. Studies by Sim and Rasiah and Mitra et al also showed that discrimination index correlated poorly with difficulty index[10,11]. While, study done by Pandey et al showed positive correlation between difficulty and discrimination indices. Study done by Ho et al showed that too easy or too difficult items discriminate poorly.Framing distracters for MCQ is the more challenging task for the examiners or paper setters. Distracters need to be plausible. If a distracter is not selected by atleast 5% of the students, that distracter is non functional. In the present study, out of total 150 distracters, only 13(8.66%) are found to be non-functional distracters. 137(91.34%) are functional distracters in present study. Total 10(20%) items with NFDs are identified. 8(16%) items with 1 NFD and distractor effectiveness (DE) of 66%, 1(2%) item with 2 NFD and DE of 33.33% & 1(2%) item with 3 NFDs with DE of 0% have been observed.In a study by Halikar S, all MCQs had at least one non-functional distracter. The percentage of functional distracters in this study was found to be 23].In the study of item analysis by Namdeo SK,12% MCQs had no Nonfunctional distracters. 46% of the distracters were found to be functional[9].In a study by Tarrant M conducted on 514 items and 1542 distracters, 35.1% were NFDs, 52.2% were functional distracters and 10.2% were not chosen by any student.Another review of functioning distracters by Haldyana in 477 items on four MCQ assessments showed 38% items had NFDs and items with three functional distracters ranged from only 1.1 to 8.4%.

In the study by Mehta G with 50 MCQs, having 150 distracters, 53(35.33%) were found to be NFDs, 28(18.66%) were functional distracters and 69(46.01%) distracters had nil response[6].

Gajjar S have shown that, in a total of 150 distracters, 133(89.6%) were functional distracters, and 17(11.4%) were NFDs. Items with NFDs were 15(30%) out of which 13 items had DE of 66.6% and 2items had DE of 33.33%[8].Hence, in context of distractor effectiveness, finding of present study goes with the study done by Gajjar S.Each item for being used in assessment must be evaluated based on findings of difficulty index, discrimination index & distractor effectiveness in total. Based on the values of all 3 indices, 30 items out of 50 are found to be ideal, in present study & they are preserved in departmental question bank.

Conclusion

It is concluded that items present in this study were of acceptable difficulty index (47.43±19.20) and good discrimination index (0.343 ±0.167). Hence items were neither too easy nor too difficult and good at discriminating high & low achievers. In the present study, out of total 150 distracters, only 13(8.66%) distracters are found to be non-functional. NFDs can be rectified or discarded. Item analysis in present study has been found very useful to find out the reliability of MCQ question paper & contribution for departmental question bank.

References

1. Singh T, Gupta P, Singh D. Principles of Medical Education. 3rd ed. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd, 2009, 70–77p.
2. Ramakrishnan M, Sathe AB, Vinayak A. Item analysis: a tool to increase MCQ validity. Indian J Basic Applied Med Res. 2017;6(3):67-71.
3. Anjali NilkanthappaShete, AfshanKausar, KundaLakhkar S. T. Khan. Item analysis: An evaluation of multiple choice questions in Physiology examination. J Contemp Med Edu.2015;3(3):106-109.
4. Patel KA, Mahajan NR. Itemized analysis of questions of multiple choice question exam. Int J Sci Res. 2013;2:279-80.
5. Kolte V. Item analysis of multiple choice questions in physiology examination. Indian J Basic Appl Med Res. 2015;4:320-6.
6. Mehta G, Mokhasi V. Item analysis of multiple choice questions – An assessment of the assessment tool. Int J Health Sci Res. 2014;4:197-202.
7. Patil VC, Patil HV. Item analysis of medicine multiple choice questions (MCQs) for under graduate (3rd year MBBS) students. Res J Pharm BiolChem Sci. 2015;6:1242-51.
8. GajjarS, Sharma R, Kumar P, Rana M. Item and test analysis to identify quality Multiple Choice Questions (MCQs) from an assessment of Medical students of Ahmedabad, Guajrat. Indian J Community Med. 2014; 39(1):17–20.
9. Namdeo SK, Sahoo S. Item analysis of multiple choice questions from an assessment of medical students in Bhubaneswar, India. Int J Res Med Sci. 2016;4:1716-9.
10. Sim SM, Rasiah RI. Relationship between item difficulty and discrimination indices in true/false multiple choice questions of a paramedical multidisciplinary paper. Ann Acad Med Singapore. 2006;35:67-71.
11. Mitra NK, Nagaraja HS, Ponnudurai G, Judson JP. The levels of difficulty and discrimination indices in type A multiple choice questions of preclinical semester1 multidisciplinary summative tests. Jpn Soc Mech Eng. 2009;3:2-7.

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