International Journal of Community Medicine and Public Health
Domple VK et al. Int J Community Med Public Health. 2018 Jan;5(1):254-257
http://www.ijcmph.com
pISSN 2394-6032 | eISSN 2394-6040

DOI: http://dx.doi.org/10.18203/2394-6040.ijcmph20175792

Original Research Article

Comparative study of simplified new method of item analysis with conventional method

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Received: 07 November 2017
Revised: 05 December 2017
Accepted: 06 December 2017

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ABSTRACT

Background: Most of the entrance examinations in the world use multiple choice questions for assessment. We tried a new method in which, the middle one third test papers were included in final item analysis while calculating difficulty and discrimination index.
Methods: This cross-sectional study was conducted in the month of July 2017 among 62 third year undergraduate medical students. Total 50 MCQs were framed with a four options and only one correct answer. The assessed papers arranged in descending order and two question papers with highest and lowest marks were excluded to make equal two or three groups. The item analysis was done by two methods based on difficulty index and discrimination index. Data was analyzed for standard error of difference between two proportions by Microsoft Excel.
Results: Therefore 60 students participated in the part-completion examination. The highest score was 37 whereas 15 was lowest. Out of 50 items (MCQs), 7 items were removed before final item analysis because of negative value of proportions. Out of 43 items, 25 showed that there was statistically significant difference between the discrimination index ($P<0.05$) with new method and conventional method. In rest of the 18 items, there was no significant difference ($P>0.05$) in discrimination index. Z test for two proportions showed no significant difference in the difficulty index with new and conventional method.
Conclusions: To conclude, there is no difference with respect to difficulty index by both methods but regarding discrimination index, the study failed to show conclusive results.

Keywords: Item analysis, MCQ, Difficulty index, Discrimination index

INTRODUCTION

Today multiple choice questions (MCQs) is the most commonly used tool for assessing the knowledge capabilities of medical students.[1] Most of the entrance examinations in the world use multiple choice questions for assessment. Item analysis gives an insight about the quality of items.

Item analysis is a simple procedure performed after the examination. It also tells how difficult or easy the questions were (the difficulty index) and whether the questions were able to discriminate between students who performed well on the test, from those who did not (the discrimination index).[2]

In conventional method, the graded test papers are arranged from the highest score to the lowest score in a descending order. The upper and lower 25% or 27% are better estimate of the actual discrimination value and they are significantly different and the middle values do not discriminate sufficiently. The best 25% or 27% (one third) are picked from the top and the poorest 25% or 27% (one third) from the bottom while the middle (one third) test papers are discarded.[3]

Literature search showed only one research study by Acharya et al which included only ten items which reported that new method for item analysis is shorter and simpler and it can be a good substitute for conventional method.[4]

In the new method, the middle one third test papers were included in final analysis while calculating difficulty and discrimination index and conventional method wasn't. With this background, the objective of present study was to compare the new method of item analysis with the conventional method one.

METHODS

This cross-sectional study was conducted in the month of July 2017 among third year undergraduate medical students of Dr. Shankarrao Chavan Government Medical College, Nanded. The students were taught the chapter of occupational health of community medicine subject in eight lectures. The duration of lecture was one hour weekly. The students were informed about the MCQ based examination that will be held at the end of lecture series. The questionnaire was predesigned on the topic; the MCQs were framed and verified from the syllabus of Maharashtra University of Health Sciences, Nashik so that they are not out of syllabus. Total 50 MCQs were framed with a four options and only one correct answer. All types of MCQs i.e. simple, all except, not true, all of the above, none of the above, assertion and reason, pair match type were included in questionnaire. The printed copies of questionnaire were distributed in the examination hall to all the students. All the questions were compulsory with one hour to solve the MCQs. The first author was vigilant throughout the examination in the hall. No complaint was received from the students regarding any error in the question paper. The correct MCQ was awarded one mark without any negative marking. All question papers were assessed by the author himself. The assessed papers arranged in descending order and two question papers with highest and lowest marks were excluded to make equal two or three groups.

Conventional method

All question papers (60) were arranged in descending order and 20 middle papers (middle one third) were discarded. The item analysis between 20 highest achievers (First half) and 20 lowest achievers (Last half) was carried out.

New method

The question papers were arranged in descending order and divided in two parts (30 highest achievers and 30 lowest achievers) without excluding middle part.

The item analysis was done by two methods based on difficulty index[1]and discrimination index[1].

Difficulty index: P= H+L/N×100

Where

P=Difficulty index
H=number of students answering the item correctly in the high achieving group
L= number of students answering the item correctly in the low achieving group
N= Total number of students in the two groups

Discrimination index: d= (H-L)×2/N

Where

d= Discrimination index
Where the symbols H, L and N represent the same values as mentioned above.

Data was analyzed for standard error of difference between two proportions by Microsoft Excel.

RESULTS

Therefore 60 students participated in the part-completion examination. Total MCQs were 50 with single correct response and three distracters for each item. The highest score was 37 whereas 15 was lowest. The mean score obtained by the students was 25.11 with standard deviation of 4.56 (Table 1).

Table 1: Summary statistics.

Total students	62*
Total MCQs	50
Correct response (single)	50
Highest score	37
Lowest score	15
Mean score	25.11
Median score	26
Standard deviation	4.56

*In the final analysis, 60 students were included as two question papers with highest and lowest scores were excluded to make equal two or three groups.

The discrimination index was calculated for all 50 items. Out of 50 items (MCQs), 7 items (Q.15, Q.16, Q.21, Q.25, Q.27, Q.30, Q.31) were with negative value of proportions. As the excel was unable to calculate the standard error of difference between two proportions with the negative values, these 7 items were removed before

final item analysis. As the negative value of discrimination index indicates the item was wrongly framed. Therefore final analysis was with 43 items only.

Table 2: Comparison of discrimination index by two methods.

Item	New method	Conventional method	Z	P value
1	0.23	0.01	3.82	<0.05
2	0.17	0.01	2.97	<0.05
3	0.10	0.01	2.10	0.03
4	0.03	0.02	0.40	0.68
5	0.03	0.04	-0.30	0.76
6	0.20	0.05	2.55	0.01
7	0.23	0.03	3.29	<0.05
8	0.13	0.02	2.28	0.02
9	0.13	0.03	1.95	0.05
10	0.23	0.03	3.29	<0.05
11	0.17	0.02	2.81	<0.05
12	0.03	0.03	0	0.99
13	0.33	0.05	4.23	<0.05
14	0.23	0.03	3.40	<0.05
17	0.17	0.01	2.95	<0.05
18	0.13	0.05	1.60	0.11
19	0.13	0.03	1.83	0.07
20	0.10	0.02	1.68	0.09
22	0.10	0.004	2.43	0.01
23	0.27	0.02	3.91	<0.05
24	0.07	0.01	1.61	0.11
26	0.33	0.04	4.42	<0.05
28	0.10	0.05	1.04	0.30
29	0.17	0.04	2.30	0.02
32	0.10	0.03	1.40	0.16
33	0.13	0.01	2.39	0.02
34	0.10	0.03	1.37	0.17
35	0.13	0.01	2.39	0.02
36	0.20	0.01	3.29	<0.05
37	0.23	0.04	3.18	<0.05
38	0.00	0.01	-1.04	0.30
39	0.10	0.04	1.15	0.25
40	0.07	0.01	1.49	0.14
41	0.07	0.01	1.49	0.14
42	0.17	0.02	2.65	0.01
43	0.23	0.01	3.90	<0.05
44	0.03	0.02	0.19	0.84
45	0.07	0.05	0.39	0.69
46	0.37	0.05	4.64	<0.05
47	0.20	0.01	3.33	<0.05
48	0.20	0.03	2.98	<0.05
49	0.13	0.05	1.60	0.11
50	0.27	0.02	3.85	<0.05

Out of 43 items, 25 showed that there was statistically significant difference between the discrimination index ($p<0.05$) with new method and conventional method. In rest of the 18 items, there was no significant difference ($p>0.05$) in discrimination index (Table 2).

Table 3: Comparison of difficulty index by two methods.

Item	New method	Conventional method	Z	P value
1	61.6	55	0.74	0.46
2	48.3	55	-0.73	0.46
3	55	47.5	0.82	0.41
4	25	30	-0.61	0.54
5	91.6	92.5	-0.17	0.86
6	80	80	0.00	1
7	55	57.5	-0.28	0.78
8	73.3	77.5	-0.53	0.59
9	70	67.5	0.30	0.76
10	45	42.5	0.28	0.78
11	78.3	82.5	-0.58	0.56
12	85	82.5	0.37	0.71
13	40	40	0.00	1
14	51.6	55	-0.37	0.71
17	78.3	72.5	0.74	0.45
18	20	20	0.00	1
19	73.3	75	-0.21	0.83
20	11.6	15	-0.54	0.59
22	35	25	1.20	0.23
23	83.3	80	0.47	0.63
24	73.3	80	-0.87	0.38
26	53.3	55	-0.18	0.85
28	15	15	0.00	1
29	38.3	40	-0.19	0.85
32	35	32.5	0.29	0.77
33	80	75	0.66	0.51
34	88.3	90	-0.29	0.76
35	80	75	0.66	0.51
36	30	25	0.61	0.54
37	38.3	40	-0.19	0.85
38	73.3	67.5	0.70	0.48
39	41.6	42.5	-0.09	0.92
40	36.6	30	0.78	0.44
41	23.3	30	-0.83	0.41
42	38.3	42.5	-0.47	0.64
43	55	47.5	0.82	0.41
44	5	7.5	-0.57	0.57
45	90	90	0.00	1
46	65	65	0.00	1
47	83.3	87.5	-0.65	0.51
48	63.3	60	0.38	0.70
49	10	10	0.00	1
50	73.3	70	0.41	0.68

Z test for two proportions showed no significant difference in the difficulty index with new and conventional method (Table 3).

DISCUSSION

The present study compared the difficulty index and discrimination index with new and conventional method. These two indices are complementary to each other and both should be considered while selecting the items in question bank.[5]

Results of Acharya et al showed no difference in difficulty and discrimination index with both the methods.[4]

The present study found that there was no significant difference in the difficulty index with both the methods. So both the methods can fulfill the purpose of item analysis. There was significant difference in the discrimination index in 60% of the items while 40% didn't show any significant difference. So the difficulty index showed that both methods were equally useful but the discrimination index could not show the conclusive results. Inspite of acceptable difficulty index for an item, it should be deleted or rejected if with zero or negative discrimination index.[5] Similar results were observed in the present study. So the new method could not give conclusive results with discrimination index.

Strength of study

Analysis of 50 items (MCQs) with participation of 60 students was the strength of study.

Limitation

The limitation of study was that we could find only one study for discussion. Further study is needed with large sample size for comparison of both methods.

CONCLUSION

To conclude, there is no difference with respect to difficulty index by both methods but regarding discrimination index, the study failed to show conclusive results.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Domple VK, Dixit JV, Dhande VS. Comparative study of simplified new method of item analysis with conventional method. Int J Community Med Public Health 2018;5:254-7.