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Role of Multiple Choice Questions in Assessment of Competency of Knowledge in Anatomy

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ABSTRACT

Objectives: *The main objective of the current study is to examine the items using the item analysis to assess their competency of knowledge in human anatomy.* ***Methods:*** *This is a quantitative descriptive cross-sectional study conducted at the Najran University faculty of Medicine, in the department of anatomy. A 31-second year MBBS students of level three took the multiple-choice question exam comprising 100 questions in one session. Each item was analyzed by item analysis. The planned period of data collection is the first semester of the academic year 2019-2020. The data were analyzed using SPSS version 25, and Excel Software. All analyses were performed using the descriptive frequency, explore and correlation probabilities a p-value, p<0.01 (2-sided) was considered to indicate statistical significance.* ***Results:*** *The assessment of test items use the item analysis that is very difficult question: 25; 25%, difficult question: 8; 8%, average question: 46; 46%, easy questions; 9; 9% and very easy: 9; 9%. The discrimination indices, which are poor discrimination; 34; 34%, acceptable discrimination; 11; 11%,good discrimination; 6; 6%, very good discrimination; 4; 4% and excellent discrimination; 45; 45%. The performance of students in this test showing that a large number of items have a role in distinguishing students knowledge in the anatomy test, but in Simple parts of the scale that the items did not succeed in assessing students. Items of anatomy exams displayed a strong relationship of difficulty (P) and discrimination (D) indices.* ***Conclusion:*** *The MCQs items assess their competency of knowledge in human anatomy. The competence of students in the knowledge of anatomy measured at a high rate of A-type context-rich MCQs can be stem is case scenario, lead-in; question and options; distractors, and key. These items can differentiate good and poor accomplishment students..*

Keywords: Item analysis, MCQ A-type, Difficulty index, Discrimination index, Distractor effectiveness, Correlation coefficients

INTRODUCTION

In professional exams, multiple-choice questions are used frequently to assess student knowledge in medical and other sciences. The precise, reliable, and timely assessment of students is an important domain of teaching during medical courses. The Multiple Choice Questions (MCQ) is one method assessment of students. Although it evaluates students cognitive knowledge but does not assess professional skills. Nevertheless, it is said that MCQs highlight recall of factual information rather than conceptual understanding and interpretation of concepts [1]. If the MCQs constructed professionally can assess higher cognitive processing of Bloom's taxonomy such as interpretation, synthesis, and application of knowledge, instead of just testing recall of isolated facts [2,3]. Well-formulated MCQs assess cognitive, affective, and psychomotor domains, are preferred over other methods because they ensure objective assessment, the minimal effect of examiners bias, comparability, and cover a wide range of subjects [4]. Test with MCQ and analyzing their options have become the choice of many examiners in medical colleges [5].

Higher ordered thinking usually defined about the cognitive domain of Bloom's Taxonomy. The first levels, which are considered the lowest rank of thinking, include remembering and understanding while the rest of the four levels, which constitute the highest ranked thinking, including application, analysis and evaluation, and creation of knowledge in ascending order [6].

Assessment formats are mere tools and their usefulness can be disadvantaged by their poor design, proficiency of its user, deliberate abuse, and unintentional misuse [7]. To establish the usefulness of a particular assessment format, the following five criteria should be considered: reliability, validity, influence on future thinking, practice, suitability to learners and teachers and expenses to the individual student and institution [8].

Gajjar et al., [4] examined the quality of MCQ tests, emphasized that a good MCQ OH really assess the knowledge, and was able to discriminate the dissimilar abilities of students. While D'Sa, et al. [9] concluded that MCQ was an effective tool for measuring the achievement of learners. Vyas, et al. [10] recommended that MCQs with three replacements should be preferred than the four or five options. MCQs A type: describe, as the one is one that requests the students to select the best or correct answer. Frequently have 4 or 5 options for the student to choose from them. There is no psychometrical law limited the number of options. Furthermore, the three options technique has more tractability and discrimination than more options technique; it saves time of teachers, gives them a chance to use that time to add additional questions, and improves the validity of exams [11].

Creating high-quality items is a significant feature of educational assessment. Analyzing the banking items for future use that will enhance the quality of the assessment and the results of the study will provide an opportunity to change the way that MCQs are developed and used in educational assessment. To assess the different domains it is important to have good items [9]. Item analysis is a process that assesses the quality of those items and the test as a whole [12].

Rao, et al. [13] concluded in his study must initiate a change in the MCQ test items are selected for any examination, and there must be a good assessment strategy as part of the curriculum development. Much more of these kinds of analysis must be carried out after each examination to identify the areas of potential weakness in the A type of MCQ tests to improve the standard of assessment. Item analysis examines the student responses to individual test items (MCQs) to assess the quality of those items and test as a whole [14].

Difficulty Index (Dif. I) or (P) defines as the percentage of students who selected the correct response. The higher the value of Dif. I, the item is easier and vice-versa [15].

Discrimination Index (item effectiveness-Dis I) indicates how effectively the question can discriminate (sort out) the students who know the material from those who do not. There are many indices to express discrimination. The point biserial (PBS) must be used to express the Disc Index. The biserial ranges from -1 to +1. Dis I of 1 is considered as ideal, which can efficiently discriminate between high and low achievers [16].

The previous study reveals that test items with good discrimination coefficient have a widely positive correlation between difficulty and discrimination indices. Item analysis improves exams and gives it reliability and validity, which functions as implement to evaluate students and instructional quality [17]. Higher the difficulty index low is the difficulty of the question. The difficulty index and discrimination index are reciprocally related [18].

These items can discriminate between good and poor-performing students. Therefore, it will be helpful to improve our teaching and learning process and the low achievers will give more imperative teaching. A valid question bank is necessary for proper assessment. The ultimate goal of any teaching will remain sterile unless it is evaluated and until it is assessed. By MCQ, there is an analysis of the teaching-learning process and by item analysis; the analysis of the assessment method done [19]. The present study conducted to demonstrate the ability and analysis of the role of MCQ in testing the competence of knowledge in human anatomy.

MATERIALS AND METHODS

This is a quantitative descriptive cross-sectional study conducted at the Najran University faculty medicine, in the department of anatomy. A 31-second year MBBS students of level three took the multiple-choice question A-type (MCQ) exam comprising 100 questions in one session. It is good construction MCQ Items. During the evaluation process of MCQ's, each correct response was award 0.4. Each item was analyzed by item analysis (difficulty index, discrimination index, and distractor effectiveness). The planned period of data collection is the first semester of the academic year 2019-2020. The Mendeley software used to cite references.

Interpretation

Difficulty Index (P) if:

p-value	Quality	Recommendation
• ≤ 0.20	• Very Difficult	• Should be revised
• 0.21-0.30	• Difficult	• Retained in the Questions bank
• 0.31-0.69	• Average	• Retained in the Questions bank
• 0.70-0.80	• Easy	• Revised before re-use
• ≥ 0.81	• Very easy	• Ignored or carefully reviewed

Discrimination Index (D) if:

D-value	Quality	Recommendation
• D=Negative	• Defective items/wrong key	• Exactly discard
• D<0-0.19	• Poor discrimination	• Discard
• D between 0.2-0.29	• Acceptable discrimination	• Need to review
• D between 0.3-0.39	• Good discrimination	• Scope of improvement
• D=0.4	• Verygood discrimination	• Retain
• D>0.4 y	• Excillent discrimation	• Retain

Methods of Statistic

The data were analyzed using (SPSS Software) statistical social package for social sciences (Version 25 SPSS, Chicago, Illinois USA) and Excel Software. All analyses were performed using the descriptive frequency, explore and correlation probabilities a p-value, $p<0.01$ (2-sided) was considered to indicate statistical significance.

The Pearson correlation is a parametric measure of the correlation of two variables. It measures both the power and the direction of a linear relationship. If one variable X is an exact linear function of another variable Y, a positive relationship exists if the correlation is +1.0 and a negative relationship occurs if the correlation is -1.0. If there are no linear predictions between the two variables, the correlation is 0.0. The following guidelines have been proposed in Table 1 [20]:

Table 1 Guidelines Coefficient, r

Coefficient, r		
Strength of Association	**Positive**	**Negative**
Small	0.1 to 0.3	-0.1 to -0.3
Medium	0.3 to 0.5	-0.3 to -0.5
Large	0.5 to 1.0	-0.5 to -1.0

Post validation of the paper was done by item analysis. The scores of all the students were arranged in order of merit. The upper one-third of students were considered as high achievers and lower third as low achievers. Each item was analyzed [16] Difficulty Index (Dif. I) or Facility value or p-value using the formula:

$P=H+L/N \times 100$

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 (including non-responders).

II Discrimination index (DI) or d value using the formula [16]:

D=H-L × 2/N

Where the symbols H, L, and N represent the same values as mentioned above.

Distractor Effectiveness (DE) or Functionality

The correlation coefficient (Kr20): Measures reliability of test items with binary variables reliability refers to the coefficient to the quantity of constancy of the results of a test. The score varies from (0) to (-1.0) is no reliability and (+1) is perfect reliability. Kr20 score closer to (1), the more reliable the test. Score above (0.5) is considered reasonable, Kr20=(k/k-1) x (1-q)/var.). Whereas k=sample size for the test, var.=variance for the test, p=proportion of people passing the item, q=proportion of people failing the item, =sum up [19].

RESULTS

Figure 1 shows the interpretation of the item analysis difficult indices of hundred test items in human anatomy; the course that called anatomy-1 and includes the: general introduction anatomy, upper limb, lower limb, and embryology. The assessment of test items use the item analysis that are very difficult question: 25; 25%, difficult question: 8; 8%, average question: 46; 46%, easy questions; 9; 9% and very easy: 9; 9%.

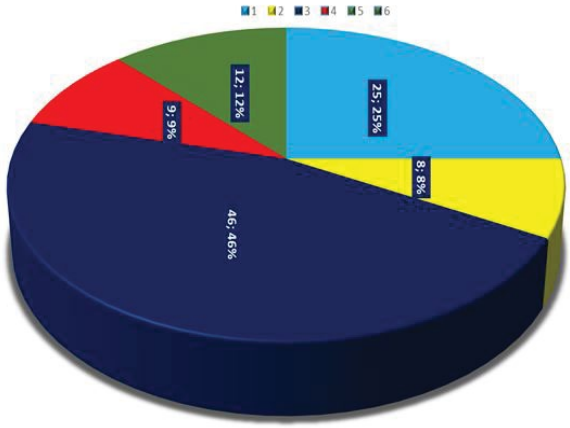

Figure 1 Explains Difficulty Index of Test Items

Figure 2 shows the distributions of interpretation of discrimination index of test items using a tool to distinguish the students in their performance. The discrimination indices, which are poor discrimination; 34; 34%, acceptable discrimination; 11; 11%, good discrimination; 6; 6%, very good discrimination; 4; 4% and excellent discrimination; 45; 45%.

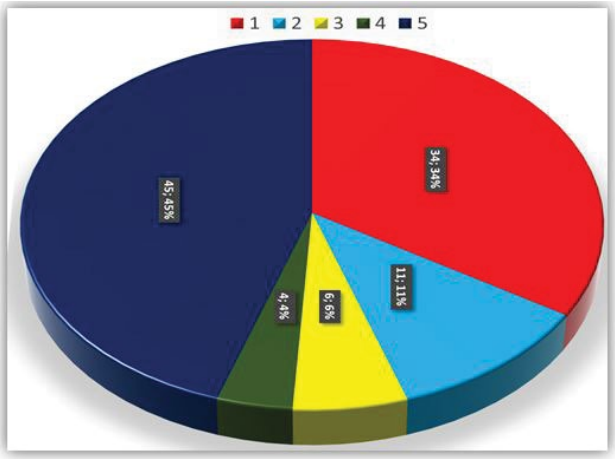

Figure 2 Explains Discrimination Index of Test Items

Box plots were used to demonstrate the general structures for evaluating the anatomy test items of medical school students for clusters from item analysis; how difficult, easy, and distinguished students are in this test. It gives an important way to visualize the range and the different distinctions to assess the items. Figure 3 illustrates the items of difficulty and discrimination indices. The four areas of each Box plot were unbalanced in size; this box plot talks about the performance of students in this test showing that a large number of items have a role in distinguishing students 'knowledge in the anatomy test, but in Simple parts of the scale that the items did not succeed in assessing students. Long Bottom Mustache of the difficulty index box means a few items have failed to assess students 'knowledge of some items in this test and may have been for another reason.

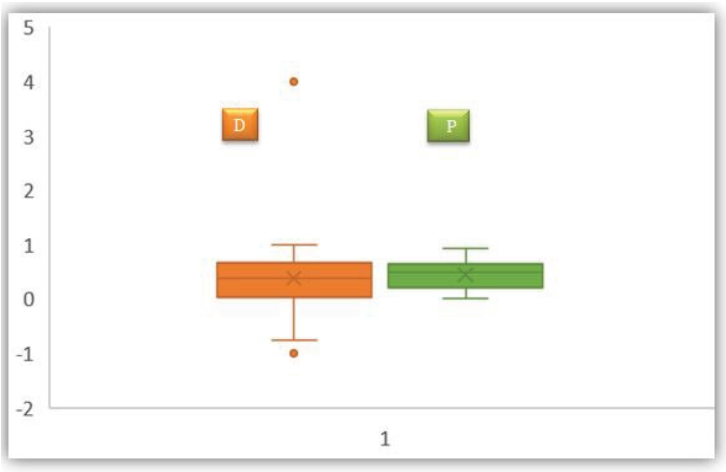

Figure 3 Shows the Item Analysis Scores of Human Anatomy Test

Figure 4 explains the items of anatomy exams and displayed the relationship of difficulty (P) and discrimination (D) indices. It shows the strength of association (coefficient, r 0.1 to 1) between P and D. Also shows, 66% of the items distinguish between higher and lower achiever of the course and therefore measure the knowledge and competence the student in this course. Also, the figure shows the dots of P and D are centered between the 0.1 to 1, shows the strong relationship between them.

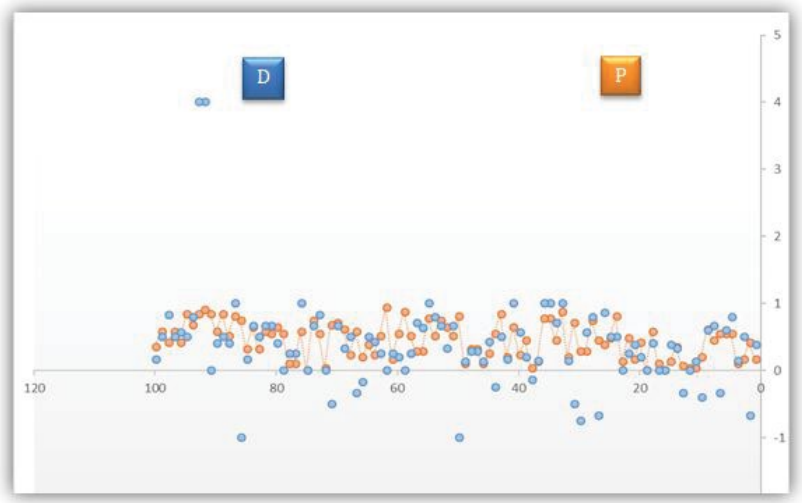

Figure 4 Demonstrate the relationship of difficulty and discrimination indices of human anatomy test

DISCUSSION

The current study demonstrated the competency of multiple-choice questions (MCQs) for knowledge assessment of Anatomy. The items constructed very well, therefore the strong positive relationship between the difficult and dis-

crimination indices, which reinforce the ability of MCQs in knowledge anatomy like any science, agreed with both Ingale, et al. [2] and Case, et al. [3] in their study which they said in its summary: ''If the MCQs constructed professionally can assess higher cognitive processing of Bloom's taxonomy such as interpretation, synthesis, and application of knowledge, instead of just testing recall of isolated facts''.

The finding of this study indicates the significance of MCQs items for determining the perceptions of the deep knowledge of clinical and applied anatomy. This finding supported by Krathuvohl, in his study summary [6], "first two levels, which are measured as lower ordered thinking, comprise remembering and understanding whereas rest of the four levels, establishing higher-ordered thinking, include application, analysis, evaluation, and creation of knowledge in ascending order" according to the cognitive domain of Bloom's Taxonomy.

The competence of students in the knowledge of anatomy measured at a high rate of A-type context-rich MCQs can be stem is case scenario, lead-in; question and options; distractors, and key. These items can differentiate good and poor accomplishment students. Therefore, it will be beneficial to improve our teaching and learning process and the low achievers will give the most urgent teaching; this context corresponds to the author Panchal, et al. [19] in MCQ mode, there is an analysis of the educational learning process and element analysis; Analysis of the evaluation method.

CONCLUSION

The MCQs items assess their competency of knowledge in human anatomy. The competence of students in the knowledge of anatomy measured at a high rate of A-type context-rich MCQs can be stem is case scenario, lead-in; question and options; distractors, and key. These items can differentiate good and poor accomplishment students.

DECLARATIONS

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Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

[1] Srivastava, Anurag, Anita Dhar, and Chander S. Aggarwal. "View point-why MCQ." *Indian Journal of Surgery,* Vol. 66, 2004.

[2] Ingale, Abhijeet S., Purushottam A. Giri, and Mohan K. Doibale. "Study on item and test analysis of multiple choice questions amongst undergraduate medical students." *International Journal of Community Medicine and Public Health,* Vol. 4, No. 5, 2017, pp. 1562-65.

[3] Case, Susan M., and David B. Swanson. "Extended-matching items: A practical alternative to free-response questions." *Teaching and Learning in Medicine: An International Journal,* Vol. 5, No. 2, 1993, pp. 107-15.

[4] Gajjar, Sanju, et al. "Item and test analysis to identify quality multiple choice questions (MCQs) from an assessment of medical students of Ahmedabad, Gujarat." *Indian Journal of Community Medicine,* Vol. 39, No. 1, 2014, p. 17.

[5] Hingorjo, Mozaffer Rahim, and Farhan Jaleel. "Analysis of one-best MCQs: The difficulty index, discrimination index and distractor efficiency." *JPMA-Journal of the Pakistan Medical Association,* Vol. 62, No. 2, 2012, pp. 142-47.

[6] Krathuvohl, David R. "A revision of bloom's taxonomy." *Theory into Practice,* Vol. 4, No. 4, 2002, p. 212.

[7] Borich, Gary, and Tom Kubiszyn. "Educational testing and measurement, classroom apllication and practice, 2013.

[8] Van Der Vleuten, Cees PM. "The assessment of professional competence: Developments, research and practical implications." *Advances in Health Sciences Education,* Vol. 1, No. 1, 1996, pp. 41-67.

[9] D'Sa, Juliana Linnette, and Maria Liza Visbal-Dionaldo. "Analysis of multiple choice questions: Item difficulty, discrimination index and distractor efficiency." *International Journal of Nursing Education,* Vol. 9, No. 3, 2017, pp. 109-14.

[10] Vyas, Rashmi, and Avinash Supe. "Multiple choice questions: A literature review on the optimal number of options." *National Medical Journal of India,* Vol. 21, No. 3, 2008, pp. 130-33.

[11] Kehoe, Jerard. "Writing multiple-choice test items." *Practical Assessment, Research, and Evaluation,* Vol. 4, No. 1, 1994, p. 9.

[12] Chandra, Shalini, et al. "Medical education/original article creating valid multiple-choice questions (MCQs) bank with faculty development of pharmacology." *Indian Journal of Physiology and Pharmacology,* Vol. 62, No. 3, 2018, pp. 359-66.

[13] Rao, Chandrika, et al. "Item analysis of multiple choice questions: Assessing an assessment tool in medical students." *International Journal of Educational and Psychological Researches,* Vol. 2, No. 4, 2016, p. 201.

[14] Menon, A. R., and N. K. Prithi. "Item analysis to identify quality multiple choice questions." *National Journal of Laboratory Medicine,* Vol. 6, No. 6, 2017, pp. 7-10.

[15] Matlock-Hetzel, Susan. "Basic concepts in item and test analysis." *Educational Research Association,* 1997, pp, 1-7.

[16] Pande, Sushma S., et al. "Correlation between difficulty and discrimination indices of MCQs in formative exam in physiology." *South-East Asian Journal of Medical Education,* Vol. 7, No. 1, 2013, pp. 45-50.

[17] Ahmed, I., and Adel Abdullah Moalwi. "Correlation between difficulty and discrimination indices of MCQs type A in formative exam in anatomy." *Journal of Research and Method in Education,* Vol. 7, No. 5, 2017, pp. 28-43.

[18] Mehta, Gyata, and Varsha Mokhasi. "Item analysis of multiple choice questions-an assessment of the assessment tool." *International Journal of Health Sciences and Research,* Vol. 4, No. 7, 2014, pp. 197-202.

[19] Panchal, Padamjeet, Bheem Prasad, and Sarita Kumari. "Multiple choice questions-role in assessment of competency of knowledge in anatomy." *International Journal of Anatomy and Research,* Vol. 6, No. 2, 2018, pp. 5156-62.

[20] Bewick, Viv, Liz Cheek, and Jonathan Ball. "Statistics review 7: Correlation and regression." *Critical Care,* Vol. 7, No. 6, 2003, p. 451.