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Scientific, Educational, Linguistic& Formative (SELF) evaluation of a sample of pulmonary multiple choice questions

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Abstract : Multiple choice questions (MCQs) have long been used for testing knowledge acquisition. SELF evaluation strategy was recently created and published in literature. The purpose of this study is to apply the SELF evaluation strategy on a sample of MCQs within the field of respiratory disorders. A number of clinical vignette were discussed and learners were instructed to pick up the best answer. Discrimination and difficulty indices were calculated for all questions included. It is concluded that SELF evaluation strategy is feasible and practical, even among first time users, to assess the validity of MCQs within the field of respiratory disorders. It is recommended to spread using SELF evaluation strategy among academics to develop competency and capabilities.

Keywords : Evaluation strategy, questions, testing, pulmonary diseases.

Introduction

Scientific, Educational, Linguistic& Formative (SELF) evaluation is a systematic approach for designing the best multiple choice questions (MCQs) exams that serve to satisfy all aspects of having valid and reliable questions.^[1] SELF evaluation is a feasible but robust assessment strategy that enables academics to follow a logic steps toward having a comprehensive MCQs that cover all dimensions of learning supported with original work that assure resting the choice on the best available scientific evidence.^[1,2] SELF evaluation was originally created by Dr. El-gohary to guide academics to amend their proposed MCQs and polish it before having it ready for administration to examinee.^[1,3] Dr. El-gohary based his strategy on real MCQs and discussed the evidence behind choosing one and omitting the other choices. The values obtained from the statistical analysis of the included questions were reported and distributed within the difficulty and discrimination indices matrix (Appendix 1). Since SELF evaluation strategy is gaining popularity among academics, the need to evaluate a sample of MCQs within the field of cardiopulmonary becomes essential to assure its integrity.^[4] Additionally, there is a desperate need among academics to include some standardized stand- alone and case

cluster MCQs within the field of cardiopulmonary studies.^[5] The objective of this paper is to apply the SELF evaluation strategy on a sample of MCQs that were given and other proposed questions along with discussing and analyzing its scientific and educational aspects. It is hypothesized that the newly created strategy would serve as a comprehensive assessment tool to be adopted by academics within the field of cardiopulmonary studies to have standardized MCQs exams.

Materials and Methods

Sampling

A large sample of MCQs from different exams of courses taught at respiratory therapy department was chosen and carefully selected to represent all dimensions of educational categories, all levels of scientific evidence, linguistic soundness, and formative structure.^[6-11] For the purpose of discussion, a sample of MCQs with four answer options will be fully discussed with justifying the reason of picking up one answer while omitting the rest of options. Decision making for answering questions will be substantiated based on the best available evidence.

Clinical Vignette One:

Basim is 11 years old right hand dominant student who is a member of the school swimming team. Basim suffers from Asthma and usually experiences the exercise induced asthma (EIA) that lasts more than 10 minutes.

Q1: The best statement that applies for the Asthma diagnosis is:

- a) A restrictive pulmonary disease where lung volumes are essentially normal
- b) A restrictive pulmonary disease where lung volumes are decreased
- c) An obstructive pulmonary disease where lung volumes are essentially normal
- d) An obstructive pulmonary disease where lung volumes are decreased

Comments

The correct answer is "c" since patients diagnosed with Asthma belongs to the obstructive pulmonary diseases not the restrictive ones. Lung volumes are essentially normal and do not decrease in obstructive pulmonary diseases.^[12] The question is a mixed question since the learner needs to first know the difference between obstructive and restrictive lung diseases and follow that with knowing the lung volumes in every disease group. The scientific aspect of the question was established.^[12] The educational aspect of the question reflects the conceptual- procedural knowledge dimensions.^[13] The linguistic and formative aspects of the question were satisfied. The learner cannot guess for the answer based on grammar matching, the structure or the length of the question.

Q₂: The best standardized exercise testing to diagnose EIA is through:

- a) Running on a treadmill for 6-8 minutes at an exercise load of 95% of maximum.
- b) Running on a treadmill for 10-15 minutes at an exercise load of 50% of maximum
- c) Pedaling on a stationary bike for 6-8 minutes at an exercise load of 95% of maximum
- d) Pedaling on a stationary bike for 10-15 minutes at an exercise load of 50% of maximum

Comments:

The correct answer is "a" since the test included in literature reported 6-8 minutes of running on the treadmill at 95% load of maximum.^[14,15] SELF evaluation strategy was conducted. The scientific soundness of the question was supported by original research work. The educational aspect of the question reflects lower order thinking skills in the knowledge- comprehension- application spectrum of learning.^[13] Course and program objectives were revised and aligned with the intended learning outcome, teaching strategy and evaluation process.^[16] Both of linguistic as well as formative aspects were satisfied.

Q₃: Exercise induced asthma is best treated by inhalation of:

- a) Steroids, β 2-agonists treatment after exercises and leukotriene antagonists
- b) Steroids, β2-agonists treatment before exercises and leukotriene antagonists
- c) Bronchodilators, β 2-antagonists treatment before exercises and leukotriene agonists
- d) Bronchodilators, β 2-antagonists treatment before exercises and leukotriene agonists

Comments:

The correct answer is "B" since steroids are always given in addition to β 2-agonists treatment before exercises. The leukotriene antagonists are always the choice.^[14,15] Regarding SELF evaluation process, the scientific aspect was established and supported by original research work. The educational aspect was also satisfied since the question reflected the application- analysis spectrum of Bloom's taxonomy.^[17] The question covers high order thinking skills.^[13] The respiratory care specialist needs to have excellent clinical reasoning skills to be able to have the right clinical judgment skills.^[18-20] The linguistic and formative aspects were satisfied. The clinical vignette communicates a very common respiratory disease that health care professionals encountering every day and they need to be quite sure of the best evidence based pharmacological treatment for such cases.

Clinical Vignette Two:

Hoda is a housewife who has been diagnosed with chronic obstructive pulmonary disease (COPD) seven years ago. Hoda is a heavy smoker and careless in most of medical advises given to her. Hoda has reported to the chest doctor with a later stage of COPD.

Q4: The symptoms that are more likely to be seen in later stage of COPD are:

- a) Fatigue, weight loss, and swelling of feet& ankles
- b) Fatigue, chest tightness, and frequent cold
- c) Chronic cough, lack of energy and wheezing
- d) Wheezing, chest tightness and chronic cough

Comments:

The correct answer is "a" since weight loss and fatigue are consequences of poor health in later stage of COPD. Also, swelling of feet and ankles is another bad health symptom. The other symptoms included in the "b, c, and d" are more likely to be seen at the early and intermediate stages of the COPD. The scientific aspect was supported by original work.^[21,22] The educational aspect reflected higher order thinking skills since it lies in the analysis- evaluation spectrum.^[13] The linguistic and formative aspects of the question were also satisfied.^[23,24] The question reflects course and program objectives.^[16] Rehabilitation professionals are more likely to encounter cases with COPD in everyday practice.^[21,22]

Q₅: The key feature of COPD is an:

- a) Decelerated rate of decline in forced expiratory volume in 1 second
- b) Accelerated rate of decline in forced expiratory volume in 1 second
- c) Decelerated rate of decline in forced vital capacity in 5 seconds
- d) Accelerated rate of decline in forced vital capacity in 5 second

Comments:

The correct answer is "b" since the key feature of COPD is the decline in forced expiratory volume in 1 second that takes an accelerated course.^[21,22] Option "a" was excluded since the rate is accelerated not decelerated. Options "c& d" were excluded since they were not supported by original research work. The educational aspect reflected lower order thinking skills since it lies in the recall- comprehension spectrum.^[13] The factual and conceptual knowledge are accepted with a certain percentage that reflects the course and program objectives.^[25] It also differs from the early years to the years at the end of the program. The linguistic and formative aspects of the question were also satisfied.^[23,24] Rehabilitation professionals should be able to determine the needed lung test and the interpretation of its results. The learner needs to pick up the best answer

from four options after carefully reading the clinical vignette. Short case scenario and clinical vignettes are more likely to reflect and mimic the real situations encountered in the clinical field than the stand alone MCQs.^[5,9,16]

Clinical Vignette Three:

Adam is 12 years old who has been diagnosed with rare genetic disease that results in weakness of the respiratory muscles. The pulmonologist conducted thorough examination and testing including, but is not limited to, forced expiratory volume in 1 second (FEV₁), forced vital capacity (FVC), functional capacity (FC), residual volume (RV), total lung capacity (TLC), functional residual capacity (FRC) and functional residual capacity (FRC).

 Q_6 : Which of the following findings apply to the restrictive lung disease?

- a) High FEV₁/FVC, and normal RV/TLC
- b) Low FEV1/FVC, and normal TLC
- c) High VC, low RV and low TLC
- d) Low VC, low TLC, and high RV/TLC

Comments:

The correct answer is "d" since in restrictive lung diseases the lung itself can normally function but the muscle weakness will result in grossly low lung volumes including FEV₁, FVC, and TLC. However, residual volume will be relatively high as a consequence of the muscle weakness. Therefore, the RV/TLC will be elevated.^[26] Regarding the SELF evaluation strategy, the scientific correctness of the clinical vignette was established and was supported by original research work.^[26] The educational aspect was also satisfied since it covers the evaluation- synthesis spectrum of Bloom's taxonomy.^[13,17] The question and its answer options reflect higher critical thinking skills based on good clinical reasoning and clinical judgment skills.^[18-20] The clinical skills are fundamentals for pulmonary disease specialists to have the right diagnosis based on the best available evidence.^[27,28] The course objective was under the umbrella of the program objective that is in harmony with the vision and mission of the academic institution. The academic has aligned the intended learning outcome with the teaching strategy and the evaluation technique.^[16] The learner needs adequate clinical- practical reasoning skills more than just basic theoretical skills to answer this question.^[18-20] The linguistic and formative aspects were also satisfied to ensure that learners pick up the best answer based on genuine competence rather than guessing and grammar matching.^[27,28] The pulmonologist are more likely to routinely encounter such cases.

 Q_7 : All of the following are clinical characteristics that can be seen in a patient presented with combined pulmonary fibrosis and emphysema (CPFE) except:

- a) Patients with CPFE always have lower diffusing capacity than the COPD patients
- b) Ground-glass opacities and reticular opacities are common in CPFE
- c) Honeycombing& ground-glass opacities are rare in CPFE
- d) Paraseptal emphysema is particularly common in patients with CPFE

Comments:

The correct answer is "c" since honeycombing& ground-glass opacities are common in CPFE patients.^[29] The word except denote choosing the answer that does not apply.^[23] The other three options "a, b, and d" are true for patients with CPFE. Regarding SELF evaluation strategy, the scientific aspect was established and supported by original research work. The educational aspect reflected high order thinking skills in the analysis- evaluation spectrum.^[13,17] The learner needs to analyze, evaluate and synthesize information given and exclude the answer that does not belong to the complicated patient who has a combined case of pulmonary fibrosis and emphysema. The linguistic and formative aspects were satisfied.^[23,24] The presented case communicates a difficult case that needs to be fully discussed with the learners to educate them about the best way to manage such cases.^[29-31]

Results

Discrimination and difficulty indices:

Discrimination and difficulty indices were reported to the sample of questions presented within this paper. Questions number one, two, four, five and six were reported. The indices differentiated and reported the difficulty of questions respectively.^[32,33] Questions number three and seven were not reported regarding discrimination and difficulty indices due to insufficient sample size. The template created by Dr. El-gohary (Appendix 1) was used since it is simple and self- explanatory.^[11]

Date:

Appendix 1:

Examiner's Name:

Difficulty Index& Discrimination Index			
Subject Title: Xxxxxxx			
Subject #:Xxxx			
5			
Discrimination Index	Difficulty Index		
	HARD	MEDIUM	EASY
	(0-0.29)	(0.30- 0.79)	(0.80-1)
	Question Numbers	· · · · · ·	
<i>Poor</i> < 0.1			
		Q ₂ Q ₄	Q ₁ Q ₅
<i>Fair</i> 0.1 to 0.29		Q6	
<i>Good</i> > 0.30			
To be avoided	Acceptable	Good	

<u>*NB*</u>. Discrimination index of ≥ 0.2 is desirable and difficulty index around 0.5 is also desirable.

Discussion

The authors have presented a number of MCQs that cover wide array of respiratory disorders. The authors emphasized on using clinical vignette and followed that with the MCQs.^[5] The authors used SELF

evaluation strategy to assess the validity of the included questions.^[1,34] MCQs have covered the whole learning dimensions from knowledge and comprehension through application and analysis to the evaluation and synthesis spectrum.^[6] The authors have used the SELF evaluation strategy as an educational algorithm to develop high quality MCQs exams.^[1,35] The ten points checklist created by Dr. El-gohary was followed to polish the MCQs in the way of developing competence and capabilities among learners.^[1,27,28,34]

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