International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.11 No.01, pp 341-347, 2018

Scientific, educational, linguistic& formative (SELF) evaluation strategy of a sample of intermediate musculoskeletal multiple choice questions

Tarek M. El-gohary,[1*] Abdullah M. Al-shenqiti,[2] Samiha M. Abdelkader[3]

[1]College of Medical Rehabilitation Sciences, Taibah University, Saudi Arabia
[1]Biomechanics Department, Faculty of Physical Therapy, Cairo University, Egypt
[1]Board Certified Orthopedic Clinical Specialist, USA
[1]Mechanical Diagnosis& Therapy, McKenzie Institute, USA
[2]Dean of College of medical Rehabilitation Sciences, Taibah University, Saudi Arabia
[3]Physical Therapy Department, College of Applied Medical Science, King Saud University, Saudi Arabia

Abstract : The purpose of this study was to apply the SELF evaluation strategy on a sample of multiple choice questions (MCQs) within the field of musculoskeletal disorders of intermediate level. A number of stand-alone MCQs were discussed along with the rationale of choosing one answer and excluding the other options. Discrimination and difficulty indices were calculated for all questions included. It is concluded that SELF evaluation strategy is feasible and practical, even among inexperienced academics, to assess the validity of MCQs within the field of musculoskeletal disorders. It is recommended to use SELF evaluation strategy to have quality MCQs that lead to developing competency and capabilities.
Key words: Evaluation strategy, musculoskeletal, SELF evaluation, MCQ, competence.

Introduction

Musculoskeletal courses are essential core courses within physical therapy and rehabilitation programmes. Musculoskeletal courses are designed to take learners gradually step by step from introductory courses to intermediate courses to advanced courses. The courses become more sophisticated when taught at the postgraduate level.[1,2]Multiple choice questions (MCQs) are the commonly used exams for testing knowledge acquisition;[3] however the validity of MCQs is still questionable especially in the absence of standardized technique to ensure its validity. The majority of academics reported that they rely on their own experience when creating and designing MCQs exams especially in the absence of specific framework and guidelines to follow. There is a gap in body of knowledge regarding having standardized assessment techniques for MCQs. Additionally, there is a desperate need among academics to include some standardized stand- alone MCQs within the field of musculoskeletal studies.[4]Recently, Dr. El-gohary has created and published a series of educational papers to cover the gap in the body of knowledge.[3,5,6] Dr. El-gohary created the scientific, educational, linguistic& formative (SELF) evaluation strategy to validate the quality of the MCQs.[5] We hypothesize that SELF evaluation strategy is feasible to be used by academics and can be easily applied on the

musculoskeletal MCQs. The first purpose of this educational paper is apply the SELF evaluation strategy on a sample of MCQs given at the musculoskeletal course of intermediate level, and the second purpose is to calculate the difficulty and discrimination indices of the included MCQs.

Materials and Methods

Sampling

A miscellaneous sample of MCQs from the first midterm exam of the musculoskeletal case study course were deliberately chosen to represent different levels of thinking that reflects different educational categories.[7,8] SELF evaluation strategy created by Dr. El-gohary was applied to all included questions to establish the scientific background, match its educational category, ensure its linguistic soundness and its formative output.[5] The difficulty and discrimination indices were calculated for all included questions.[9,10]Ethical approval was obtained from college of medical rehabilitation sciences. Approval # (CMR-PT-2017-010).

Q_1: When the clinician suspects puffy right lateral epicondyle area, the first step is to:

a) Look at the right olecranon bursa
b) Look at the left medial epicondyle area
c) Look at the left lateral epicondyle area
d) Look at the right medial epicondyle area

Comments:

The correct answer is (C) since the basic physical examination skills emphasize on inspecting the area of concern and its mirror in the body. Therefore, the puffy right lateral epicondyle area has its mirror on the left lateral epicondyle area.[1,2] The options "a", "b" and "d" are parts of the thorough examination process but not the first step in the physical examination of the area of concern. The clinician must prioritize the steps of physical examination with having the patient's chief complaint before his/ her eyes.[1,2] Academics should start by establishing the scientific aspect of the question. Regarding the educational aspect, this question belongs to evaluation category on the cognitive dimension and the procedural knowledge.[7,8]The question and its answer options reflects higher critical thinking skills but within the frame of physical examination of the area of concern.[11] If the evaluation within the framework of the total cluster of signs and symptoms from different body regions, then the critical thinking skills become more advanced and more sophisticated to come up with a preliminary physical therapy diagnoses.[12] Academics should have the intended learning outcomes, course objectives and program objectives readily available. Also, the teaching strategies and classroom assessment methods should be aligned with the intended learning outcomes.[13]The whole process should be under the umbrella of the vision and mission of the educational institution. The linguistic and formative aspects were satisfied. The question number one showed difficulty and discrimination indices of 0.61 and 0.15 respectively.[9,10] That can be interpreted as medium difficulty index and fair discrimination index.[5] The question can be included with full faith in the future exams.

Q_2: The best description of right side neck pain is:

a) Pain is 4/10, intermittent, and with right side neck rotation
b) Pain is 4/10, intermittent, and at end range of right side neck rotation
c) Pain is mild, increase at night, and with right side neck rotation
d) Pain is moderate, intermittent, and sometimes become constant

Comments:

The correct answer is (b) since the answer is fully descriptive and very specific compared with the rest of answers. The answer option indicated the severity, nature and behaviour of pain;[14] however options "a", "c", and "d" are lacking the specifics included in option "b". A quick run of the SELF evaluation strategy showed that the scientific aspect was established and the educational aspect was satisfied.[5] The question lies within the comprehension- analysis spectrum.[7,8] The question reflects early higher order critical thinking skills needed by every learner to demonstrate distinguished clinical skills.[12] The linguistic and formative aspects were satisfied.[5] The question number two showed difficulty and discrimination indices of 0.76 and 0.15 respectively.[9,10] That

can be interpreted as medium difficulty index and fair discrimination index. [5]The question can be included with full faith in the future exams.

Q_3: The most likely cause for winged scapula is an:

a) Injury to dorsal scapular nerve and paralysis of rhomboids
b) Injury to thoracodorsal nerve and paralysis of latissimusdorsi
c) Injury to long thoracic nerve and paralysis of serratus posterior
d) Injury to long thoracic nerve and paralysis of serratus anterior

Comments:

The correct answer is (d) sincethe winged scapula deformity is always due to paralysis of serratus anterior muscle which is supplied by long thoracic nerve.[1,15] The answer options "a" , "b",and "c" are wrong since the paralysis of the included muscles would result in different picture of deformity. A quick run of the SELF evaluation strategy has established the scientific aspect of the question. Regarding the educational aspect, it was satisfied and showed that the question lies within the knowledge- comprehension spectrum and that reflects lower order thinking skills.[7,8] The linguistic and the formative aspects were satisfied.[5] The question number three showed difficulty and discrimination indices of 0.92 and 0.07 respectively.[9,10] That can be interpreted as easy difficulty index and poor discrimination index. The question needs some changes to be included with the future exams.[5,16,17]

Q_4: The most common etiology of *non-structural scoliosis* is:

a) Leg- length discrepancy& nerve root irritation
b) Poor posture& hemi vertebrae
c) Hip contracture& wedge vertebrae
d) Wedge vertebrae& hemi vertebrae

Comments:

The correct answer is (a) sinceleg length discrepancy and nerve root irritation are classified as non-structural causes that can result in scoliosis.[1,2,15]The answer options "b" , "c", and "d" are wrong since all options have included causes that can result in structural scoliosis. A quick run of the SELF evaluation strategy has established the scientific aspect of the question.[5] Regarding the educational aspect, it was satisfied and showed that the question lies within the application- analysis spectrum and that reflects early higher order thinking skills.[7,8] The linguistic and the formative aspects were satisfied.[5] The question number four showed difficulty and discrimination indices of 0.76 and 0.15 respectively.[9,10] That can be interpreted as medium difficulty index and fair discrimination index. The question can be included with full faith in the future exams.[5]

Q_5: The *comorbidities* that are more likely to be considered in cases of thoracic outlet syndrome are:

a) Whiplash injury and elbow sprains
b) Whiplash injury and chronic asthma
c) Diabetes and high blood pressure
d) Diabetes and low blood pressure

Comments:

The correct answer is (b) since whiplash injury causes derangement at the thoracic outlet which compromises the sensitive structures at thoracic outlet.[1,2] Also, patients with chronic asthma tend to use the accessory scalenes neck muscles which subsequent hypertrophy and a cascade of uncomfortable consequences at the thoracic outlet.[18] The answer options "a" , "c", and "d" are wrong since all options have included unrelated or less likely comorbidities that could be considered in cases of thoracic outlet syndrome. A quick run of the SELF evaluation strategy has established the scientific aspect of the question.[5] Regarding the educational aspect, it was satisfied and showed that the question lies within the analysis- evaluation spectrum and that reflects early higher order thinking skills.[7,8] The linguistic and the formative aspects were satisfied.[5] The question number five showed difficulty and discrimination indices of 0.69 and 0.23 respectively.[9,10] That can be interpreted as medium difficulty index and fair discrimination index that is higher than 0.2. The question

managed to differentiate more capable from less capable learners. The question can be included with full faith in the future exams.[5]

Q_6: A 55 years old female had kidney transplant 5 years ago and is on cortisone therapy, is more likely to suffer from:

a) Secondary osteoporosis
b) Primary type 2 and secondary osteoporosis
c) Primary type1 and secondary osteoporosis
d) Primary type 1and type 2 osteoporosis

Comments:

The correct answer is (c) since the female patient around age of 55 years is more likely to suffer from primary type one osteoporosis.[1,2] Also, being a kidney transplant patient is more likely to suffer from secondary osteoporosis.[1,2] The answer options "a" , "b", and "d" are wrong since all options have included insufficient or wrong answers. A quick run of the SELF evaluation strategy has established the scientific aspect of the question.[5] Regarding the educational aspect, it was satisfied and showed that the question lies within the analysis- evaluation spectrum and that reflects early higher order thinking skills.[7,8] The linguistic and the formative aspects were satisfied.[5] The question number six showed difficulty and discrimination indices of 0.65 and 0.1 respectively.[9,10] That can be interpreted as medium difficulty index and fair discrimination index. The question fairly managed to differentiate more capable from less capable learners.[5]The question can be included with full faith in the future exams.[5]

Q_7: The surgical procedure that is best performed for young individuals with unicompart degenerative changes at the knee joint is:

a) Synovectomy
b) Arthrodesis
c) High tibial osteotomy
d) Total knee replacement

Comments:

According to the academic the correct answer is (c) since the degeneration of one component in young individual needs high tibial osteotomy.[1,2] The answer options "a" , "b", and "d" are wrong since all options have included inappropriate surgical procedures. A quick run of the SELF evaluation strategy did not establish the scientific aspect of the question.[5] Regarding the educational aspect, it was not satisfied since the scientific aspect is a prerequisite to move towards evaluating the educational aspect.[5]The linguistic aspect was not satisfied since the academic should have used unicompartmental instead of unicompart.[16]Also, the academic did not indicate the age of the individual or the severity of degeneration.[5]The formative aspect was satisfied but is very poor.[5] The question is classified as stand- alone MCQs where case cluster and short case scenario are preferred to mimic a real life clinical cases.[4] Moreover, the question does not reflect the course or program objectives. Furthermore, the academic did not do any difficulty or discrimination indices. The question is lacking the minimal requirements to differentiate more capable from less capable learners.[5]The question must be excluded from any future exams.[16,17,19]

Results

Difficulty and discrimination indices:

Difficulty index and discrimination index of the included questions were included.[5,9,10] Difficulty index is a measure of item difficulty and it reflects the percentage of students who were capable of answering the question correctly in that given test. The difficulty index of 0.5 is classified as medium difficulty and is desirable. The discrimination index is used to differentiate between the performances of more capable against less capable students on a particular question. A discrimination index of 0.2 and above is desirable. The values of the difficulty and discrimination indices of the discussed MCQs were included in the template created by Dr.El-gohary (Appendix 1).[5]

Appendix 1:
Examiner's Name: Date:

Difficulty Index& Discrimination Index			
Subject Title: Musculoskeletal case study			
Subject #:Xxxx			
Discrimination Index	**Difficulty Index**		
	HARD (0- 0.29)	**MEDIUM** (0.30- 0.79)	**EASY** (0.80- 1)
	Question Numbers		
Poor< 0.1			Q_3
Fair 0.1 to 0.29		Q_1 Q_2 Q_4 Q_5 Q_6	
Good> 0.30			
To be avoided	Acceptable	Good	

***NB*. Discrimination index of ≥ 0.2 is desirable and difficulty index around 0.5 is also desirable.**

Discussion:

Evaluation is one of the fundamentals of having quality education.[5,6] Unfortunately, academics are lacking the adequate skills to use specific evaluation methods to test different students' capabilities.[20]Recently, Dr. El-gohary had created and published a series of educational papers that had covered a wide range of educational aspects that are essential for academics including but is not limited to the guiding principles for developing exam guiding skills among inexperienced academics,[3] SELF evaluation strategy for MCQs exams,[5] discussing the blueprint matrix to design MCQs exams,[6] and providing feasible difficulty and discrimination index template for academics.[6] The quality of the published educational papers has prompted many academics to apply the available strategies on a sample of the MCQs included at different exams. The published educational papers are considered as a milestone to set a framework for having high quality MCQs

exams.[5]Academics indicated that the skills included within the educational papers seem to be feasible and readily available to be immediately applied without the need for extensive training since most of the skills are self- explanatory, have the interactive questions& answers, and supplemented with feasible templates for users.[3,5,6] The MCQs discussed within this educational paper proved to be valid for future use by academics. The questions had been evaluated from all aspects using the SELF evaluation strategy along with its difficulty and discrimination indices under the umbrella of course and program objectives driven from vision and mission of the educational institution.[5] Therefore, the musculoskeletal MCQs included should be adequate to test learners' competence and capabilities within the musculoskeletal course.[20]

References

1) Magee DJ. Orthopedic physical assessment: musculoskeletal rehabilitation. 6th ed. Saunders Company; 2013
2) Cook C, and Hegedus E. Orthopedic Physical Examination Tests: An Evidence-Based Approach. 2nd ed.; Pearson Company; 2011
3) El-gohary TM. Multiple choice questions exams: Guiding principles to develop exam designing skills among novice& inexperienced academics. IJTRR. 2017;6:42-48.
4) Vuma S, Sa B. A Comparison of clinical-scenario (case cluster) versus stand-alone multiple choice questions in a problem based learning environment in undergraduate medicine. J TaibahUniv Med Sc 2017;12:14-26.
5) El-gohary TM. An introduction to scientific, educational, linguistic& Formative (SELF) evaluation strategies for a subject-specific multiple choice questions exams. Int J ChemTech Research. 2017; 10:650-657.
6) El-gohary TM. Dr. El-gohary blueprint matrix: A feasible template purported to be a quick and simple guide for academics to design robust multiple choice questions exams. IJTRR. 2017; 6: 38-44.
7) Bloom's taxonomy. Available at:https://cft.vanderbilt.edu/guides-sub-pages/blooms-taxonomy/Accessed on October 15th- 2017.
8) Bloom's Taxonomy of Educational Objectives. Available at: http://teaching.uncc.edu/learning-resources/articles-books/best-practice/goals-objectives/blooms-educational-objectives. Accessed on October 20th, 2017.
9) Pande SS, Pande SR, Parate VR, Nikam A, Agrekar SH. Correlation between difficulty& discrimination indices of MCQs in formative exam in physiology. South-East Asian Journal of Medical Education. 2013;7:45-50.
10) Taib F, Yusoff MSB. Difficulty index, discrimination index, sensitivity and specificity of long case and simple choice questions to predict medical students' examination performance. J TaibahUniv Med Sc. 2014;9:110-114.
11) Critical thinking skills. Available at: https://www.skillsyouneed.com/learn/critical-thinking.html. Accessed on November 9th, 2017.
12) Ten Critical thinking and clinical reasoning - Pearson Higher. Available at: https://www.pearsonhighered.com/content/dam/region-na/us/higher-ed/en/products-services/course-produ. Accessed on November 12th, 2017.
13) Meyers NM, Nulty DD. How to use (five) curriculum design principles to align authentic learning environments, assessment, students' approaches to thinking and learning outcomes. Assessment & Evaluation in Higher Education. 2009; 34:565-577.
14) Kyte DG, Calvert M, van der Wees PJ. et al. An introduction to patient-reported outcome measures (PROMs) in physiotherapy. Physiotherapy. 2015;101:119-125.
15) Levangie PK, Norkin CC. Joint structure and function. A comprehensive analysis. 4th ed. Philadelphia, PA: F.A. Davis Company; 2005.
16) Center for innovation in teaching and learning. Improving your test questions. Multiple choice. Available at: https://citl.illinois.edu/citl-101/measurement-evaluation/exam-scoring/improving-your-test-questions#multiple. Accessed on November 25th 2017.
17) Al-Rukban MO. Guidelines for the construction of multiple choice question tests. J Family Community Med. 2006; 13: 125–133.
18) Hattam P, Smeatham A. Special tests in musculoskeletal examination. An evidence-based guide to clinicians. New York: Churchill Livingstone, Elsevier; 2010.

19) Orthopedic specialist certification candidate guide- ABPTS. Available at: http://www.abpts.org/uploadedFiles/ABPTSorg/Specialist_Certification/Orthopaedics/SpecCert_Orthopa. Accessed on July 20th- 2017.
20) Rethans JJ, Norcini JJ, Baron-Maldonado M, Blackmore D, Jolly BC, LaDuca T, et al. The relationship between competence and performance: Implications for assessing practice performance. Medical Education. 2002; 36:901-909.

*****