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Dr. El-gohary blueprint matrix: A practical application purported to be a simple guide for academics to design robust formative multiple choice questions midterm exams

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Abstract : Context: Test blueprint is essential for developing standardized multiple choice questions (MCQs) exams. Academics need simple blueprint to have a proportion of MCQs that covers all dimensions of Bloom's taxonomy. **Objectives**: To provide academics with feasible blueprint to be used in designing formative midterm exams along with easy calculation equation. **Methods**: The authors described the global test blueprint for the biomechanics and kinesiology course, and the distribution of MCQs across the cells of the blueprint matrix. **Results:** About 95% of the academics participated reported that the blueprint template is simple and self-explanatory to design midterm MCQs exams. **Conclusions**: It is recommended to use Dr. El-gohary blueprint matrix by academics to design formative midterm multiple choice questions exams.
Keywords: Test blueprint, MCQs, midterm exam, content analysis.

Introduction

A test blueprint is fundamental for developing standardized multiple choice questions exams (MCQs). It organizes the process of test development to best reflect the essential elements of competency for the profession being assessed.[1-3]It specifies the proportion belongs to each content area and the proportion of each level of the cognitive dimension. These proportions indicate the relative importance of different content area to

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represent the competency and capabilities needed.[4]Test blueprint improves consistency across different test forms. It guides academics to define scope and focus of the test, and ensuring congruence between the intended learning outcomes and the course content. It also helps in determining the alignments of learning objectives, teaching strategies and assessment techniques.[1-4]

Academics are always either using formative or summative exams. Formative exams denote a quiz administered during the course while summative exams denote a test administered at the end of the course which is considered as the final exam.[3,5]There are uncertainty and insufficient information regarding the ability of the academics to successfully use Dr.El-gohary blueprint matrix for developing formative blueprint midterm exams. We hypothesize that Dr. El-gohary blueprint matrix is feasible and readily available to be used by academics for midterm exams. The purpose of this educational paper is providing academics with simple, self-explanatory matrix to be used in designing a blueprint for their formative midterm exams driven from every subject global or detailed test blueprint.

Table 1. Global test blueprint for the biomechanics and kinesiology of the first year

Content Area	**Total Weightage (%)**	**Recall (%)**	**Interpretation (%)**	**Problem Solving (%)** "Apply, analyze, evaluate, Synthesize"
Introduction/ SI units, Planes& Axes Arthrology	20 %	5	5	10
Static Equilibrium	15 %	10	0	5
Scalar and Vectors Resolution of Forces	20 %	0	5	15
Muscle Mechanics	15 %	5	5	5
Tissue Mechanics	10 %	0	5	5
Mechanics of Exercise Prescription	20 %	0	0	20
	N/A			
	N/A			
	N/A			
	N/A			
	N/A			
	N/A			
	N/A			
	N/A			
	N/A			
Total	**100%**	**20%**	**20%**	**60%**

Methods and Materials

The global test blueprint for the biomechanics and kinesiology course of the first semester taught at the first academic year is presented (Table I). The blue print covers only six topics taught at the first six weeks. The academic responsible for teaching this course assigned number of MCQs that corresponds to the weightage of every topic and the content area belongs to different levels of Bloom's taxonomy.[6,7]The matrix created by Dr. El-gohary will be used to demonstrate the distribution of the MCQs at different levels of Bloom's taxonomy.[8]The author has included two matrices; the first matrix (Appendix I) is a blank one to be used by academics in their respective subjects while the second matrix (Appendix II)is showing the distribution of 20 MCQs exam. Regarding the second matrix, the top row is showing the six levels of cognitive processes dimension, according to the hierarchy of Bloom's taxonomy,[6,7,9-11] with the suggested percentage and some of the action verbs used. The left column is showing the number of topics included in this midterm exam. Since

topics have different weights then we have to adjust accordingly. The author made sure that the sum of the questions belongs to every topic matches the number derived from the topic weight as a percentage of its total course time. Also MCQs belongs to every dimension of Bloom's taxonomy were added to ensure accuracy of its percentage. A number of academics, with over ten years of academic experience, were instructed to carefully double check the matrix for accuracy and simplicity for readers. Ethical approval was obtained from college of medical rehabilitation, Taibah University.(Approval#CMR-PT-2017-011).

Appendix I

*Subject's Name& No:**Biomechanics and Kinesiology***

		Acquisition of knowledge as hierarchy of Bloom's Taxonomy						
		Knowledge Recall % Identify-Label	**Comprehension Interpret %** Describe- Explain	**Application Demonstrate %** Calculate- illustrate	**Analysis Formulate%** Discuss- Solve	**Evaluation Appraise %** Judge- Estimate	**Synthesis Integrate %** Create-Write	
		( )	( )	( )	( )	( )	( )	
								Sum
( )	**Topic 1**							
( )	**Topic 2**							
( )	**Topic 3**							
( )	**Topic 4**							
( )	**Topic 5**							
( )	**Topic 6**							
( )	**Topic 7**							
( )	**Topic 8**							
( )	**Topic 9**							
( )	**Topic 10**							
( )	**Topic 11**							
( )	**Topic 12**							
( )	**Topic 13**							
( )	**Topic 14**							
( )	**Topic 15**							
Total ( )		**Sum=**	**Sum=**	**Sum=**	**Sum=**	**Sum=**	**Sum=**	**Total=**

Appendix II

Subject's Name& No:

		Acquisition of knowledge as hierarchy of Bloom's Taxonomy						
		Knowledge Recall 20% Identify-Label	**Comprehension Interpret 20%** Describe-Explain	**Application Demonstrate 10%** Calculate-illustrate	**Analysis Formulate 15%** Discuss- Solve	**Evaluation Appraise 20%** Judge- Estimate	**Synthesis Integrate 15%** Create- Write	
		(4)	**(4)**	**(2)**	**(3)**	**(4)**	**(3)**	
								Sum
(4)	**Topic 1**	Q	Q		Q	Q		4
(3)	**Topic 2**	Q, Q				Q		**3**
(4)	**Topic 3**		Q	Q		Q	Q	**4**
(3)	**Topic 4**	Q	Q				Q	**3**
(2)	**Topic 5**		Q		Q			**2**
(4)	**Topic 6**			Q	Q	Q	Q	**4**
Total (20)		**Sum= 4**	**Sum= 4**	**Sum= 2**	**Sum= 3**	**Sum= 4**	**Sum= 3**	**Total = 20**

Results

About 95% of the academics that participated indicated that the blueprint template is simple, self-explanatory and takes users step by step to design robust exam. They indicated that they are eager to use it in the future exams. Global test blueprint (Table 1) showed easy vertical summation of different levels of Bloom's taxonomy and easy horizontal summation of topics included in the midterm exam. Appendix one was generic, self-explanatory to be used regardless the number of topics covered. Appendix two was self-explanatory; having the questions included reflecting the six topics covered until the first midterm exam in addition to all levels of Bloom's taxonomy. The author included a very simple equation to calculate questions needed for every level of Bloom's taxonomy and weightage of different topics. Academics agreed upon the accuracy of the simple equation included to calculate the percentage assigned to every level of Bloom's taxonomy in addition to the percentage assigned to different topics. Academics added that every user should adjust any fractions to the closest integer and make sure that the total number is correct.

Discussion

The presented template provides simple but robust tool to guide academics in designing MCQs exam, having the distribution and percentages of questions that reflect content area at every cognitive level readily available.[12-14] Academics participated in this study indicated that there is scarcity of feasible template that would be a quick guide when developing the blueprint for their educational subjects. Academics added that using the blueprint is axial to standardize and establish all psychometric measures of the MCQs exams.[14,15]Furthermore, academics confirmed that the blueprint helps in ensuring that analysis, evaluation, and synthesis skills are covered.[2,9,16]Academics reported that test blueprint served as a map to establish the total weightage for each content domain and proportion of test items assigned for each sub-category of a test according to modified Bloom's taxonomy.[7,17,18] Academics are in agreement that efforts put in having good blueprint improves test content validity which improves score interpretation.[14,19] Moreover, test blueprint will improve educational experiences among academics.[20] MCQs exams that satisfy the difficulty and discrimination indices are considered as well- structured and can reliably be administered on large scale to students as well as health care providers.[1,2,21,22]There is consensus among academics that the level of difficulty should be considered when designing the blueprint since the objectives needed from courses taught at early years of study emphasizes on knowledge acquisition while the objectives at the end of the program emphasizes on critical thinking skills.[12,13,23,24]Therefore, the MCQs exam should have a higher percentage of questions in the analysis-evaluation and evaluation-synthesis spectrum.[25,27] Higher levels of critical thinking are the core of developing not only competence but capability as well in the ever changing health field but it needs intensive training from academics.[23-25]

Conclusions

It is recommended to use Dr. El-gohary blueprint matrix by academics to design formative midterm multiple choice questions exams. Academics should ensure that they have included enough proportion of questions above the knowledge- cognitive dimension in order to assess high order thinking skills.

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