



香港中文大學
The Chinese University of Hong Kong



香港中文大學醫學院
Faculty of Medicine
The Chinese University of Hong Kong



Quality and Item Analysis of Student-generated Multiple-choice Questions

F. W. K. Tang, H. Y. Cheng, S. W. S. Lo

Prof. Fiona Tang, Associate Professor (Practice in Nursing)

PhD (Nursing) PGD (Psychology) RN PRCC (Primary Health Care Nursing) FHKAN (Education) APN (Education & Research in Nursing)

Introduction

Multiple-choice questions (MCQs)

- Objective & efficient assessment
- Limit to surface learning, but not deep learning



Surface learning



Deep learning

MCQ development

✓ Active learning

✓ Higher-order thinking

Grainger, R., Dai, W., Osborne, E., & Kenwright, D. (2018). Medical students create multiple-choice questions for learning in pathology education: A pilot study. *BMC Medical Education*, 18(1), 1-8. <https://doi.org/10.1186/s12909-018-1312-1>
Sagala, P. N., & Andriani, A. (2018). Development of higher-order thinking skills (HOTS) questions of probability theory subject based on Bloom's Taxonomy. *Journal of Physics: Conference Series*, 1188 (1), 012025. <https://doi.org/10.1088/1742-6596/1188/1/012025>



香港中文大學
The Chinese University of Hong Kong



CU
Medicine
香港中文大學醫學院
Faculty of Medicine
The Chinese University of Hong Kong



Methods

Aim:

- To develop a question bank & revision exercises using student-generated MCQs
- To evaluate the quality of student-generated MCQs

1. MCQ writing workshop

Structure of MCQ

Stem → Who is the Vice-Chancellor of CUHK 2023-2024?

Key/Answer → A. Professor Rocky Tuan.

Distractors → B. Professor Joseph Sung.
C. Professor Charles K. Kao.
D. Professor Ma Lin.

Key & Distractors

- Differentiate students who achieved or have not mastered the learning outcomes
- All options are equally attractive to uninformed students without confusing the informed students.

Which of the following is a circle?

A. B. C. D.

A. B. C. D.

Writing Tips

- ✓ Determine what to be examined
- ✓ Write the stem & answer
- ✓ Comparable distractors

1 Which of the following is a circle?

A. B. C. D.

1 2

2. MCQ writing exercise

- Develop 2 four-option MCQs (cardiovascular, mental health nursing)
- Provide answers & explanations
- Assess higher-order thinking skills

Assessment of student-generated MCQs

Quality of Student-generated MCQs

Score	Description			
	Correctness	Relevance	Clarity	Usability
1	Incorrect information (question stem, answer & explanation)*	Irrelevant to the topic(s)	Lack of clarity	Not usable without substantial revision
2	Incorrect information (question stem, answer & explanation)*	Slightly relevant to the topic(s)	Insufficient clarity	Not usable without substantial revision
3	Correct information (question stem, answer & explanation)	Relevant to the topic(s)	Significant lapses in clarity	Usable in question bank with considerable revision
4	Correct information (question stem, answer & explanation)	Relevant to the topic(s)	A few lapses in clarity	Usable in question bank
5	Correct information (question stem, answer & explanation)			

*Please circle incorrect information in question stem

Rubric for Categorizing Cognitive Level of MCQs

	Level 1 Knowledge	Level 2 Comprehension	Level 3 Application	Level 4 Analysis	Level 5 Evaluation
Level of thinking	Lower-order		Higher-order		
Key skills assessed	Identify, recall, memorize	Describe, distinguish	Infer, predict	Interpret, judge, critique, analyse	Evaluate, examine
Characteristics	<ul style="list-style-type: none"> Recall information Memorize basic knowledge 	<ul style="list-style-type: none"> Show understanding of concepts or terms Understand the meaning of a single concept 	<ul style="list-style-type: none"> Apply information in a new context Predict the outcome in a new situation Use a concept in a patient case 	<ul style="list-style-type: none"> Apply information in a new context Interpret data Go through multiple steps & apply those connections to a situation Select the best conclusion 	<ul style="list-style-type: none"> Apply information in a new context Use several pieces of information to understand the whole situation, combining information to infer which is most probable. Assess information to support an argument



Revision exercise

- 30 MCQs with the highest score in quality assessment & cognitive level
- Item analysis

QUESTION 1

1 points

Save Answer

Jason, a 50-year-old male, has been currently diagnosed with stage 2 hypertension. Jason has had a history of asthma for 30 years and would experience exacerbations occasionally. Anti-hypertensive drugs are prescribed to him to control his blood pressure. After reviewing his past medical history, which of the following anti-hypertensive drugs should **NOT** be prescribed to him?

- A. Captopril.
- B. Propranolol.
- C. Nifedipine.
- D. Indapamide.

QUESTION 2

1 points

Save Answer

One hour after administering IV furosemide (Lasix) to a client with heart failure, a short burst of ventricular tachycardia appears on the cardiac monitor. Which of the following electrolyte imbalances should the nurse suspect?

- A. Hypocalcemia.
- B. Hypermagnesemia.
- C. Hypokalemia.
- D. Hypernatremia.

Results

- Total no. of MCQs: 118

Table 1. Quality of Student-generated MCQs (n = 118)

Correct	Relevance	Clarity	Usability
113 (95.8%)	117 (99.2%)	88 (74.6%)	77 (65.3%)

Table 2. Cognitive Level of Student-generated MCQs (n = 118)

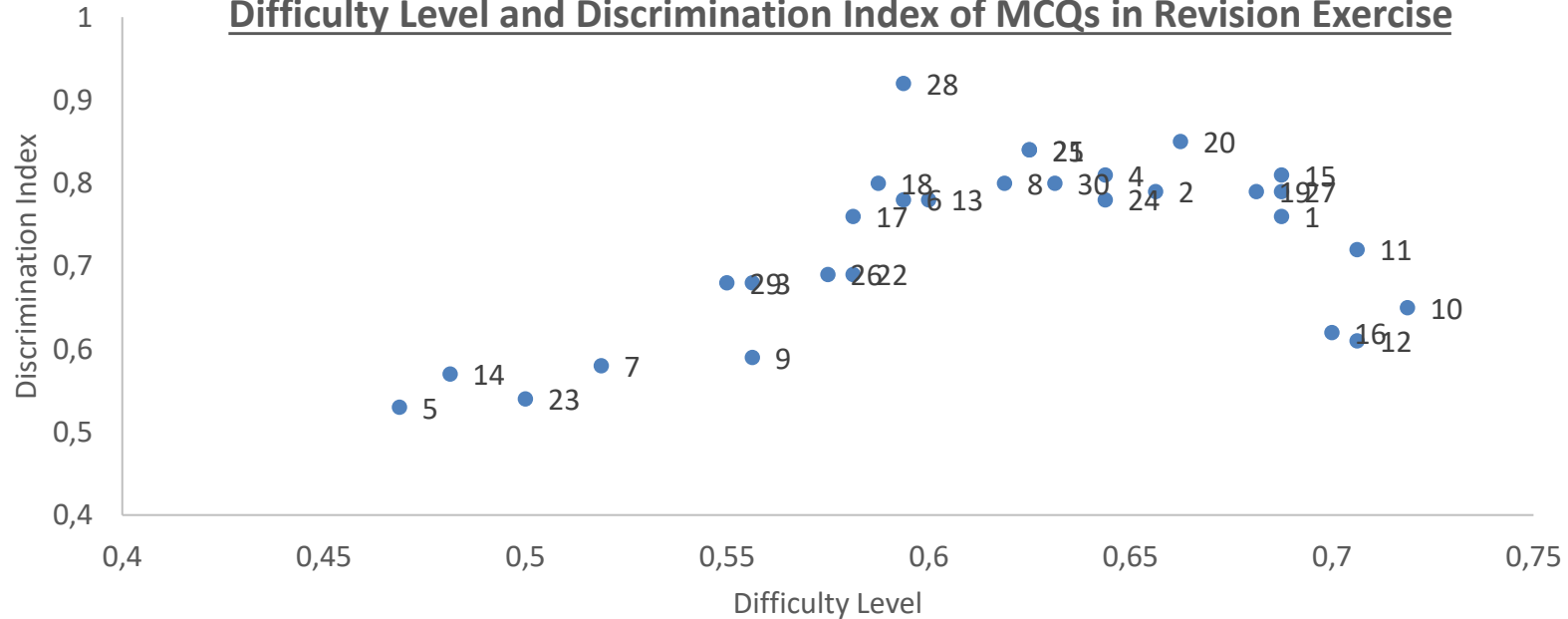
Remember	Understand	Apply	Analyse	Evaluate
27 (22.9%)	20 (16.9%)	43 (36.4%)	26 (22.1%)	2 (1.7%)

Item analysis of 30 MCQs in Revision Exercise

Table 3. Response rate and results of revision exercise (n=252)

Attempt	Results
83.7%	18.43/30

Difficulty Level and Discrimination Index of MCQs in Revision Exercise



Examples

Difficulty level: 0.54; Discrimination index:0.78

A nurse is assessing suicidal risk among four clients. Based on the information, which of the following clients has the highest suicidal risk?

- A. A 25-year-old male who recently lost his job and is experiencing financial difficulties. He has mentioned feeling overwhelmed but without any psychiatric medical history and bought two bottles of sleeping pills yesterday.
- B. A 40-year-old single female expresses feelings of sadness and isolation with thoughts of self-harm or suicide after divorce.
- C. A 60-year-old male diagnosed with a terminal illness. He has expressed significant distress and hopelessness about his prognosis, but he has a supportive family.
- D. A 47-year-old female who has a history of self-harm and has recently experienced a breakup. She has been isolating herself, giving away personal belongings, and has written a suicide note.**

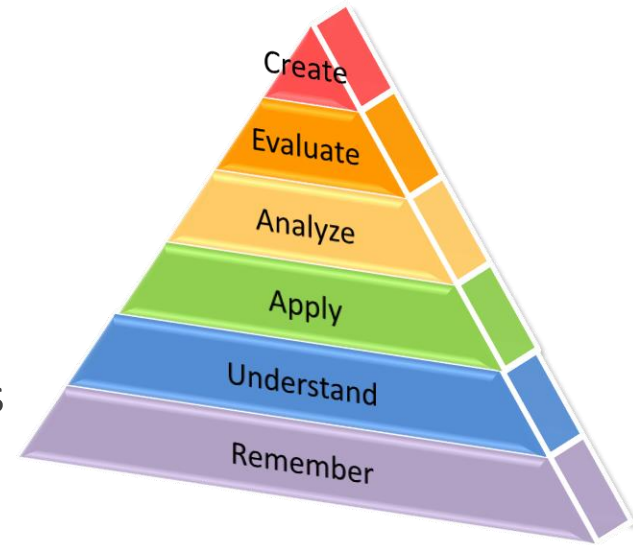
Explanation:

Assessing suicidal risk involves considering various factors such as the presence of active suicidal thoughts, intent, plan, access to lethal means, and recent warning signs or behaviors. Based on the information provided, client D presents more immediate and concerning signs of high suicidal risk, including a history of self-harm, recent breakup, isolation, giving away personal belongings, and a suicide note. These factors indicate a higher level of distress, intent, and planning to suicide.



Discussion

- Feasible approach to promote deep learning
- Consolidate learning
- Exercise higher-order thinking
- High correctness: understanding of the content
- Satisfactory usability: MCQs writing skills
- Difficulty level: comparable to teacher-prepared MCQs
- High discrimination index: examine higher-order thinking skill



D'Sa, J. L., Visbal-Dionardo, M. L. (2017). Analysis of multiple choice questions: Item difficulty, discrimination index and distractor efficiency. *International Journal of Nursing Education*, 9(3), 109-114. Doi: <https://doi.org/10.5958/0974-9357.2017.00079.4>

Rao, C., Kishan Prasad, H. L., Sajtha, K., Permi, H., Shetty J. (2020). Item analysis of multiple choice questions: Assessing an assessment tool in medical students. *International Journal of Educational and Psychological Researches*, 2(4), 201-204.

Limitations



Revision exercise
but not examination



Composition of MCQs is
different from examination



Unable to perform item
analysis for all student-
generated MCQs

Take home message

Student-generated MCQs



Develop good quality items



Facilitate higher-order thinking



Novel pedagogy to promote deep learning