



Construction and Evaluation of Test Items: Part 1

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UTeM 2021

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Session 3

Using Revised Bloom's Taxonomy to Create Test Items

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At the end of the session participants should be able to

- Explain Bloom's revised taxonomy of learning objectives;
- Use revised Bloom's taxonomy to construct written test items at appropriate level.



Activity – Mentimeter

Reflect on your own assessment practice.

- How do you know that the students find your assessment useful?




Characteristics of Effective Exams

- valid - providing useful information about the concepts they were designed to test
- reliable - allowing consistent measurement and discriminating between different levels of performance
- recognizable - instruction has prepared students for the assessment
- realistic - concerning time and effort required to complete the assignment

Svinicki, 1999




What makes a test good or bad? The most basic and obvious answer to that question is that good tests measure what you want to measure, and bad tests do not.



Recap – RBT

	<i>Remember</i>	<i>Understand</i>	<i>Apply</i>	<i>Analyze</i>	<i>Evaluate</i>	<i>Create</i>
Fact	Remember Facts	Understand Facts	Apply Facts	Analyze using Facts,	Evaluate using Facts,	Create using Facts,
Concept/ Principle	Remember Concepts	Understand Concepts	Apply Concepts	Concepts, Principles and	Concepts, Principles and	Concepts, Principles and
Procedure	Remember Procedures	Understand Procedures	Apply Procedures	Procedures	Procedures	Procedures
Meta-cognitive	Remember Metacog. Strategies	Understand Metacog. Strategies	Apply Metacog. Strategies	Analyze Meta. Strategies	Evaluate Metacog. Strategies	Create Metacog. Strategies
	<i>Knowledge</i>		<i>Skill</i>	<i>Ability</i>		

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Basic Types of Knowledge

- **Declarative knowledge**
 - knowing that something is the case / can be declared
 - information that can be conveyed in words, orally or in writing
- **Functioning knowledge**
 - refers to as intellectual skills
 - knowing how to do something
 - involves making discriminations, applying facts, concepts & rules that govern relationships; often includes motor skills and cognitive strategies

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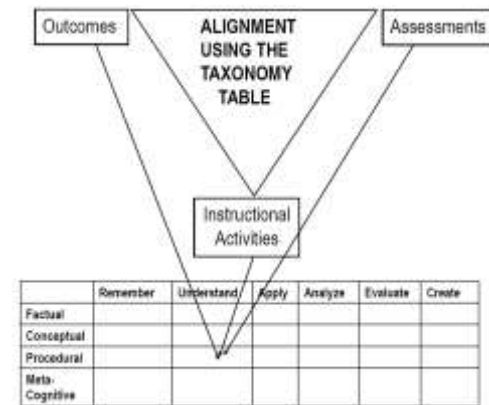


Checklist: Constructing Test Items


- Do the test items match the course outcomes?
- Do the test items relate to what was actually taught?
- Do the test items measure important concepts rather than trivia?
- Do the test items measure more complex behaviour, such as ability to make practical applications, rather than simply measuring recall or understanding of basic principles?
- Are the test items free from vaguely defined problems, ambiguous wording, extraneous or irrelevant information, and unintentional clues to the correct answers?



Test Blueprint




- Visual representation of alignment between course activities & outcomes




The goal is to discover what students know and can do, not to create tricky questions.

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Test Format - What type of Questions?

- Refer to Tables of Item Distribution & Classification
- Keyword verbs for each level
 - Example of keyword verbs
 - Types of questions



Well, we may not be able to read, but when these signs pop up, it usually means they're trying to poison us...

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Different Styles and Formats for Exam Questions

- Objective Questions (multiple choice, true/false, matching, fill-ins)
- Short-Answer Questions
- Identify an object or position - graphical hotspot
- Essays
- Scenario-based Problems
- Performance Tests
- Take Home Exams/Open Book Exams –
<https://www.youtube.com/watch?v=wyO4uAeZsyY&t=146s>
- Gobbets
- Odered-Outcomes
- There is no single best type of exam question: the important thing is that the questions reflect your learning outcomes.



Example: Matching Type

- Pick the phrase in column (B) that most accurately defines each of the phrases in column (A).

Column A	Column B
1. Long-standing silicosis	(A) Hypertrophy of the left ventricular
2. Constrictive pericarditis	(B) Cor pulmonale
3. Rheumatic heart disease	(C) Mitral and aortic stenosis
4. Systemic hypertension	(D) Subpulmonic stenosis
	(E) Congestive failure without cardiac enlargement

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Multiple Choice Question

As societies increase in complexity from folk to industrial, social control is more likely to be exercised in what?

stem

a. family
b. school
c. state
d. peer group
e. religious structures

distracters

key

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Examples of different varieties of multiple-choice items

(1) The correct answer variety

- Who discovered recombinant DNA (rDNA) technology?
 - H.G. Khorana
 - J.D Watson
 - Sutton & Boveri
 - Cohen & Boyer

(2) The best answer variety

- Restriction enzymes are

a. DNA unwinding enzymes	b. DNA joining enzymes
c. DNA cleaving enzymes	d. None of these

(3) The multiple response variety

- What factors are principally responsible for the clotting of blood?
 - contact of blood with a foreign substance
 - contact of blood with injured tissue
 - oxidation of haemoglobin
 - presence of unchanged pro thrombin

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(4) The incomplete statement variety

- Millions of ringgit worth of rice are destroyed annually in Malaysia by ____.

a. mildews b. molds c. rusts d. smuts

(5) The negative variety

- Which of these is NOT true of viruses?

a. Viruses live only in plants and animals. b. Viruses reproduce themselves.
c. Viruses are composed of very large living cells. d. Viruses can cause diseases.

(6) The substitution variety

(7) The incomplete alternatives variety

(8) The combined response variety

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UTM Example - Hotspot

Paper-based question

Diagrams 1 and 2 on the worksheet show part of the graph $y = f(x)$.

(a) On Diagram 1, draw the graph of $y = -f(x)$.

(b) On Diagram 2, draw the graph of $y = f(x+3)$.

Hotspot version of the question

Outcome 2 (11 marks)

Diagrams 1 and 2 below both show part of the graph of $y = f(x)$.

Identify the features of the graphs of $y = -f(x)$ and $y = f(x+3)$ respectively below.

4.1) On Diagram 1, click where $y = -f(x)$ has its turning points and where it intersects with the axes.

Note that marks will only be given when all points have been identified.

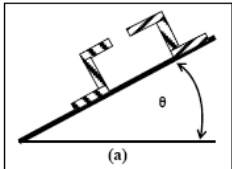
Diagram 1

Diagram 1

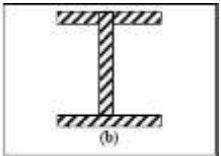
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Example: Open-ended/Open Response



(a) Purlins are beams designed to carry roof loads. You are tasked to design a Z-shaped steel section. How would you install the section to maximize the moment capacity of the beam?




(b) A simple beam with length, L and carrying a uniform load, w has an I-section made of brass. If you were to replace the I-section with a composite section made of steel and wood, recommend the dimensions and arrangement of the composite section which has the same moment capacity as the brass section.



Open-Ended/Open Response

Example:

- Excluding the effects of climate change and fisheries, discuss the various impacts that human interventions in natural systems can have on the marine environment.

 **Gobbets**

- an extract of text, a passage of literature, an image, a cartoon, a photograph, a map or an artifact provided as a context for analysis, translation or discussion in an assessment.
- Student task is to identify the gobbet, explain its context, say why it is important, what it reminds them of or whatever else you would like them to comment on.

(Biggs & Tang, 1999; Chan 2008)

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 **Example - Gobbet for a Simple Beam**

Problem posed:

You are required to design a simple beam bridge to cross a river. What information would you gather to accomplish your task and how would you use the information?

- can address higher-order cognitive abilities such as analyzing concepts and their relationships to each other.



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Example - Gobbet

A. How do you know that this graph represents a function?

B. This graph represents _____ as a function of _____.

C. What is the independent variable? What is the dependent variable? How do you know?

D. Does it matter which variable is which in this example?

E. What is the domain of the function? What is the range?

A. It shows a trend of increasing.
 B. Revenues, Telecom lower mobile revenues
 C. Independent is the image always positive.
 By Independent both positive & negative.
 D. domain: year
 range: revenues

FIGURE 3. Telecom lower mobile revenues show a high but declining growth rate awaiting 22% per year over the next five years.

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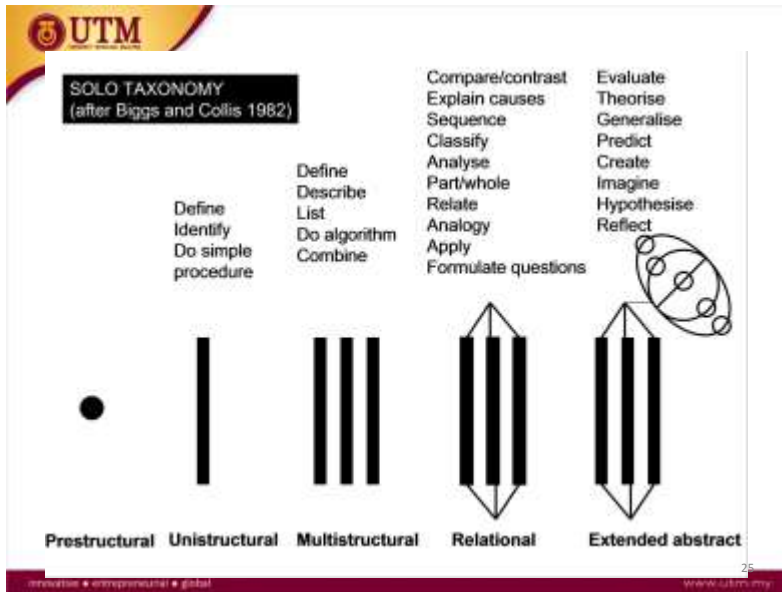
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Ordered-Outcomes Items

- Consists of a stem and 4-5 sub-items.
- The stem provides sufficient information (can be a figure, a diagram or a piece of written information) for a range of questions to be asked in the sub-items.
- The sub-items are ordered into a hierarchy of complexity that reflect the successive stages of learning of the concept or skill embedded in the stem.
- The [SOLO taxonomy](#) can be used as a guide for constructing the sub-items.
- Students' task is to answer all the sub-item questions based on the information given in the stem.
- Students' answers to the sub-item questions indicate the level of competence in that topic.

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Example – Ordered Outcomes

Based on the shipyard and production data given in the Table, determine:

- (i) The stockyard area for storing the ship's plating and sections. (8 marks)
- (ii) Whether the number of cranes in the stockyard is capable to undertake the proposed works. (6 marks)



Example – Ordered Outcomes

Consider the sequence of odd natural numbers.

- (i) What is S_5 ?
- (ii) What is S_{10} ?
- (iii) Make a conjecture as to the pattern that emerges concerning the sum.
- (iv) Write an algebraic proof verifying your conjecture.



Example: Scenario-based

Assume that you are the consulting engineer hired by the owners to help them resolve issues related to the scenarios described in (i) to (iii). For each scenario, provide good engineering advice to the owners, based on your understanding of air toxics, sustainable development, life cycle analysis, principles of environmental quality objectives, standards and guidelines:

- i. Particulates (e.g., PM10) are being discharged due to a high rate of industrial production and the need to meet strict ambient air standards imposed by the environmental regulators.
- ii. Mining of industrial metals (e.g., copper, iron) to meet a high industrial demand while ensuring a sustainable development for future generations.
- iii. Implementing the principles of life cycle analysis to ensure a generic pharmaceutical production plant remains profitable and environmentally "green".



Generic Problem (Felder, 2002)

Given...(describe the process or system to be analyzed and state the values of known quantities), *write in order the equations you would solve to calculate...*(state the quantities to be determined). *Just write the equations—don't attempt to simplify or solve them. In each equation, circle the variable for which you would solve, or the set of variables if several equations must be solved simultaneously.*

➤ ...if they can write equations that can be solved sequentially for the variables of interest, given sufficient time they could grind through the detailed calculations.



Example – Performance Test Item

Task

Find some existing data (eg: weather statistics for a month, rainfall, sports stats, etc). Ensure you have a data set of **at least 30** figures

Once you have your data, compile a frequency table and frequency histogram based on your data
Ensure both are **labelled correctly**

Create a stem and leaf plot of your data

Find the mean, mode, median, minimum score, maximum score and range for your data set

Create a Box and Whisker plot for your data set

Write a short reflection of you work: Which part did you find the easiest? Which did you struggle with? Which of the different ways of displaying data best described your data set?

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Creating the Questions

- Refer to cognitive level specified
- Keyword verbs for each level
- What type of questions?
 - Gobbets
 - Ordered - Outcomes Question
 - Concept maps
 - Venn Diagram etc

The diagram illustrates Bloom's Taxonomy with the following segments:

- Synthesis:** The student solves a problem by putting information together that requires original, creative thinking. Verbs: combine, merge, create, formulate, plan, organize, assemble, design, prepare, construct, arrange.
- Evaluation:** The student makes qualitative and quantitative judgments according to set standards. Verbs: justify, value, measure, compare, appraise, assess, evaluate, predict, select, choose, focus, rate.
- Analysis:** The student separates information into component parts. Verbs: distinguish, debate, compare, differentiate, contrast, diagram, calculate, solve, inspect, test, analyze, inventory, connect, appraise, relate, correlate, experiment, evaluate.
- Application:** The student solves a problem by using the knowledge and appropriate generalizations. Verbs: apply, show, illustrate, use, demonstrate, schedule, practice, dramatize, employ, test, recall, relate.
- Comprehension:** The student changes information into a different symbolic form/language. Verbs: restate, report, express, describe, tell, locate, explain, discuss, review, identify, recognize, translate, interpret.
- Knowledge:** The student recalls or recognizes information. Verbs: define, name, describe, repeat, label, record, test, recall, relate.


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Common Key Verbs in Test Items


To Measure	Ask These Kind of Questions
Remember (Facts, Terms, Principles, Procedures)	Define, Describe, Identify, Label, List, Match, Name, Reproduce, Outline, Select, State
Understand (Knowing and Interpreting Material)	Convert, Defend, Estimate, Distinguish, Explain, Generalize, Provide Examples, Predict, Summarize
Apply (Solving Problems, Applying Concepts or Principles Learned to New Situations)	Demonstrate, Modify, Operate, Prepare, Produce, Relate, Show, Solve, Use
Analyze (Recognize unstated assumptions or fallacies to distinguish between facts and inferences)	Diagram, Differentiate, Distinguish, Illustrate, Infer, Select, Relate, Point out, Separate
Evaluate (Judging and Assessing)	Compare, Contrast, Appraise, Criticize, Describe, Justify, Interpret, Support
Create (Integration of Learning from Different Areas as well as Solving Problems through Creative Thinking)	Categorize, Combine, Devise, Design, Explain, Generate, Organize, Plan, Reconstruct, Revise, Tell

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 **Activity – Bloom’s Revised Taxonomy Question Creation Worksheet**


Competence	Skill Demonstrated	Objective Verbs	Topic:
Remembering	Observation and recall information • knowledge of dates, events, places • knowledge of major ideas	arrange, define, duplicate, label, list, memorize, name, order, recognize, relate, recall, repeat, state, identify, describe	Example Question:
Understanding	Understanding information • grasp meaning • interpret facts, compare, contrast • order, group, infer causes	classify, describe, discuss, explain, express, identify, indicate, locate, report, restate, convert, review, select, translate	Example Question:
Applying	Use information • use methods, concepts, theories in new situations • solve problems using required skills or knowledge	apply, choose, demonstrate, dramatize, employ, illustrate, modify, interpret, operate, practice, schedule, sketch, solve, use, write	Example Question:
Analysing	Seeing patterns • organizing parts • recognition of hidden meanings • identification of components	analyze, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, differentiate, examine, experiment, question, test	Example Question:
Evaluating	Compare and discriminate between ideas • assess value of theories • make choices based on reasoned arguments • verify evidence • recognize subjectivity	appraise, argue, assess, check, attach, choose compare, defend estimate, judge, predict, hypothesise, rate, select, support, value, evaluate	Example Question:
Creating	Use old ideas to create new ones • generalize from given facts • relate knowledge from several areas • predict, draw conclusions	arrange, assemble, collect, compose, construct, create, invent, devise, design, plan, develop, formulate, manage, organize, plan, prepare, make, propose, set up, write	Example Question:

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 **TRY IT YOUR SELF**

1. Select one outcome in your course.
2. Based on the outcome, identify the appropriate expectation for each Bloom’s level.
3. Decide the highest level to be achieved by your students (you may write your learning outcomes based on this level)
4. Prepare an exam question that is appropriate to the expected level.

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The Taxonomy Table

COGNITIVE PROCESS DIMENSION

KNOWLEDGE DIMENSION	1. REMEMBER Identify Show Define State Obtain	2. UNDERSTAND Compare Describe Explain Discuss Classify	3. APPLY Apply Calculate Determine Estimate Show Find Solve	4. ANALYZE Analyse Contrast Examine Justify Predict Test Deduce	5. EVALUATE Argue Assess Evaluate Judge Validate Review	6. CREATE Construct Design Create Develop Produce Devise Integrate
FACTUAL KNOWLEDGE						
CONCEPTUAL KNOWLEDGE						
PROCEDURAL KNOWLEDGE						
METACOGNITIVE KNOWLEDGE						

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Acknowledge That Tests Can Have Flaws

- Did all the students do poorly on the same question or set of questions?
- Did students who are more able, based on other evidence, do well on the assessment?
- Did students answer the assessment appropriately but fail to give the answers you were looking for?
- Was the task well defined and clearly written?

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One Minute Evaluation

Reflect on where you are in the session and complete the following statements.

- Now I understand ...
- I still do not understand ...



Thank you