Session Title: Technical Test Item Development Workshop

Presenters:
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PART II: Ray Talke
Minds in Action

Promoting Regulatory Excellence

Standards
- Currency Standards
- Medical Standards
- Safety Standards
- Accounting Standards
- Military Standards

Who decides?

"Standard-setting organizations (SSOs), private groups that collaboratively select and adopt uniform technical standards for goods and services, are a critical element of the modern economy."

The University of Chicago Law Review, July 2003
Goals - Part I

- Gain...
  1. a brief overview the test development process.
  2. info on standard setting for test item writing.
  3. tips for writing good multiple choice items.
  4. an awareness of the most common mistakes.

WHY TEST?

Possible reasons

- Measure knowledge and skills
- Survey opinions and attitudes
- Enhance a learning experience

Poorly worded questions can adversely affect the quality of the results.

If you ever had the experience of...

- reading a test question and saying to yourself “huh?”
- finding the answer for one in another question
- being confused by pronouns. (Who is “they?”)
- trying to sort out the real question from all the superfluous information (or the big words!)

...and you don’t want to be the one responsible for creating such things, then you’re in the right place.
Do You Know?
Who sets the standard for writing test items?

A. ANSI (American National Standards Institute)?
B. ISO (International Standards Organization)?
C. the individual who writes the test item?
D. What? There’s a standard for test item-writing?

Begin
...at the beginning
Are you testing for...
- **educational events**?
  - Assess the purpose of the course. Create and use **objectives**.
- **licensing or certification**?
  - Analyze the content of the task or job. Test content should be based on this analysis.

FOCUS Part 1: Design of multiple choice questions
When installing a set of three (3) lavatories, how many traps are required?

- **answer** = A. 1 *
- distractor = B. 2
- distractor = C. 3
- distractor = D. A trap is NOT required when installed as a set.

STANDARD: the Scoring Office of Michigan State University
[http://www.msu.edu/dept/soweb/writitem.html](http://www.msu.edu/dept/soweb/writitem.html)
Tip 1

1. Keep stems and statements short. Use clear, concise language and avoid superfluous information.

The size of vent piping shall be determined from its length and the total number of fixture units connected thereto, therefore when aggregate cross-sectional area venting is used for venting, which of the following will properly vent a 4-inch building sewer?

………HUH?

Using aggregate cross-sectional area calculations, which of the following will properly vent a 4-inch building sewer?

Oh…I see. OK!

Tip 1

1. Keep stems and statements short as possible.

In _____ a water heater shall be anchored or strapped within the upper and lower one-third of its vertical dimension to resist horizontal displacement due to earthquake motion.

a) seismic design categories C, D, E, and F
b) seismic zones 3 and 4
c) seismic design categories A, B, and D
d) seismic zones 1, 2, 3, and 4

Tip 1

1. Keep stems and statements as short as possible and use clear, concise language.

BETTER

In seismic _____ a water heater shall be anchored or strapped within the upper and lower one-third of its vertical dimension.

A. design categories A, B, C, and D
B. design categories C, D, E, and F
C. zones 1, 2, 3, and 4
D. zones 3 and 4
Tip 1
1. Keep stems and statements as short as possible.

Benefits:
- Turn one question into more than one.
- Avoid unnecessarily providing clues to another test question.

The purpose of anchoring or strapping a water heater in a seismic area is to resist horizontal displacement due to earthquake motion.

1. true
2. false

Tip 2
2. For “sentence-completion” items, (A) the stem should end, and (B) the answers and distractors should complete the sentence.

The US Department of the Treasury makes:
- The US Department of the Treasury makes_____.
- The US Department of the Treasury makes__________________.

- our paper currency and produces our coins.
- overseeing human resources for the Federal Government's.
- regulate the interest rates of savings institutions and National banks.

- A. antifreeze solution; water
- B. water; antifreeze solution
- C. antifreeze solution; dry chemical
- D. dry chemical; antifreeze solution
Tip 3

OK
In occupancies serving more than _____ people, separate toilet facilities shall be provided for each sex.
A. 10
B. 15
C. 20
D. 30

Better!
Separate toilet facilities shall be provided for each sex in occupancies serving more than how many people?
A. 10
B. 15
C. 20
D. 30

Tip 4
What is wrong with this test item?
Each drainage stack serving 5 or more stories shall be served by an
A. drainage stack offset.
B. parallel vent stack.
C. parallel waste stack.
D. upper floor terminal cleanout.

Better!
Each drainage stack serving 5 or more stories shall be served by a(an)
A. drainage stack offset.
B. parallel vent stack.
C. parallel waste stack.
D. upper floor terminal cleanout.
Tip 4
4. Maintain grammatical consistency to avoid cueing.

**BETTER STILL**
Each drainage stack serving 5 or more stories shall be served by a
A. drainage stack offset
B. parallel vent stack
C. parallel waste stack
D. terminal cleanout on the uppermost floor.

**BEST**
(question form)
Which of the following is a requirement for each drainage stack serving 5 or more stories?
A. drainage stack offset
B. parallel vent stack
C. parallel waste stack
D. terminal cleanout on the uppermost floor.

Tip 4
4. Maintain grammatical consistency to avoid cueing.

Drive screws shall be used only in the horizontal position such as in the side of a beam, and only for supporting pipe sized ___ inch(es) or smaller.
A. 1
B. 1-1/4
C. 1-1/2
D. 2

Tip 5
5. Avoid negatives.

**BETTER**
Which of the following piping materials may NOT receive the discharge of a fixture into which acid or corrosive chemicals have been placed?
A. chemical resistant glass
B. copper
C. high silicon iron pipe
D. unglazed vitrified clay

All of the following piping materials may receive the discharge of a fixture into which acid or corrosive chemicals have been placed EXCEPT
A. chemical resistant glass
B. copper
C. high silicon iron pipe
D. unglazed vitrified clay.
Tip 5

5. Avoid negatives, especially double negatives.

Which one of the following is NOT a safe driving practice on icy roads?

- a) accelerating slowly
- b) jamming on the brakes
- c) holding the wheel firmly
- d) slowing down gradually

All of the following are safe driving practices on icy roads EXCEPT:

- a) accelerating slowly.
- b) jamming on the brakes.
- c) holding the wheel firmly.
- d) slowing down gradually.

…and always highlight or capitalize the words NOT and EXCEPT.

Tip 5

5. If possible, avoid negatives entirely.

The electrical demand rate for commercial enterprises can BEST be reduced by

- A. NOT starting all energy-consuming devices simultaneously.
- B. expanding power consumption without analysis.
- C. operating equipment only during peak demand times.
- D. shutting down operations all day for one day.

Tip 6

What is wrong with this test item?

Before any portion of a combination waste and vent system is installed, the code requires that

- A. the owner give his consent in writing.
- B. trap primers be installed for each trap.
- C. plans & specifications be approved by the AHJ.
- D. a separate connection be made to public sewer.
Tip 6
6. Avoid pronouns which identify gender.

Which of the following is a requirement before any portion of a combination waste and vent system is installed?

A. The owner must give written consent.
B. Trap primers must be installed for each trap.
C. Plans & specifications must be approved by the AHJ.
D. A separate connection must be made to public sewer.

NOTE: Answer options require CAPITAL letters only for the first word of a complete sentence, and for proper nouns.

Tip 7
9. Avoid conflicting alternatives. Include only one single correct or most defensible answer.

Any sprinklers that have been painted outside of the factory shall be

A. replaced.
B. replaced with a new listed sprinkler.
C. stripped of paint and cleaned before re-use.
D. replaced before freezing weather each year.
Tip 7
7. Avoid conflicting alternatives.

The way to a man's heart is through his
1. aorta.
2. stomach.
3. pulmonary veins.
4. pulmonary arteries.

Depending on your medical specialty, options 1, 2, and 3 might be true. Outside of the medical profession option 4 is true.

Tip 8
8. Avoid providing clues to the answer of one question in another question.

#14. same exam
A compartment enclosure shall be permitted to have openings in walls, provided the openings have a minimum lintel depth of how many inches from the ceiling?
A. 4
B. 6
C. 8
D. 12

Tip 9
9. Standardize the order of distractors and list them in logical order.

Numeric
smallest to largest
A. 2
B. 3
C. 4
D. 6

Text
alphabetical
shortest to longest
true/false
A. completely
B. intermittently
C. not
D. partially

A. not
B. partially
C. completely
D. intermittently

A. true
B. false
**Tip 10**

10. Avoid unnecessary repetition. Whenever possible, put repeating text in the stem.

For clothes washers in groups of three or more, which fixture unit value is assigned to each machine for the purpose of common waste pipe sizing?

A. 2 fixture units  
B. 3 fixture units  
C. 4 fixture units  
D. 6 fixture units

**Tip 11**

What is wrong with this test item?

ASSE 6000 is

1. a guide for consumers of medical care.  
2. published by the National Fire Protection Association.  
3. the principal reference guide for medical gas workers.  
4. a guide for hospital medical personnel as well as medical gas workers.

ASSE 6000 is the principal reference guide for which of the following groups?

1. consumers  
2. medical gas workers  
3. members of the NFPA  
4. hospital medical personnel
Tip 12

12. Avoid syllogistic reasoning choices

Which of the following choices are characteristics of well prepared multiple choice questions?

i. Marking is objective.
ii. The stem is phrased as a stand-alone question.
iii. Distractors are similar in length and grammar to the correct response.
iv. Stems are phrased in the negative.

a) i and ii only  
b) ii and iii only  
c) i, ii and iv only  
d) i, ii, iii, and iv

Example

Tip 12

12. Avoid syllogistic reasoning choices (e.g. “both a and b are correct”) unless absolutely necessary.

Which of the following choices are characteristics of well prepared multiple choice questions?

i. Distractors are grammatically coherent with the stem.
ii. Stems are phrased in the negative.
iii. The stem is phrased as a stand-alone question.
iv. Wording is taken directly from the study text or the standard.

a) i and ii only  
b) ii and iii only  
c) i, ii and iv only  
d) i, ii, ii, and iv

Example

Ask yourself: “Does the question test the knowledge or skills intended or rather the application of logic or reading skills?”

Other common errors to avoid

1. The longest option is usually the correct one
2. Vague pronouns (e.g. it, they)
3. Jargon and textbook language
4. Conscientious efforts to randomize your answer key
5. Inconsistency (order of distractors; abbreviations; acronyms)
6. Beware of “all of the above” and “none of the above.”
7. Incorrect grammar and punctuation. ... For example...
Common errors to avoid

Incorrect grammar ...

Farther shows a relation to physical distance.
- Our car drove farther than I thought it would on a tank of gas.
Further relates metaphorical distance, time, degree, or quantity.
- I hope that gas prices drop further before our road trip vacation.

Lineal (adjective)
- Derived from or relating to a line of descent; hereditary.
Linear (adjective)
- Of, relating to, or resembling a line; straight.

Common errors to avoid

Incorrect punctuation...

An exposed and readily accessible tubular brass trap may be used to receive urinal waste if
1. cast aluminum.
2. cast iron.
3. chrome-plated.
4. ferrous iron.

A. Verily I tell you today, you will be with me in paradise.
B. Verily I tell you, today you will be with me in paradise.

Common error

Avoid “textbook” language

Lead acid batteries for diesel engine starting have been shipped to the job dry. Which is the correct installation method?
A. Add electrolyte to the batteries, hook-up to the cables, and start the engine.
B. Add water to the batteries, charge for 24 hours, and hook-up to the engine cables.
C. Charge for 24 hours, hook up the cables, and start the engine.
D. Electrolyte shall be added at the time the engine is put in service and the battery is given a conditioning charge.
Hopefully you have gained:
- an overview the test development process.
- knowledge of standard-setting for test items.
- an awareness of the most common mistakes
- tips for writing good multiple choice items.

Item-writing standards

- Many item-writing standards are found online:
  - the Scoring Office of Michigan State University
    http://www.msu.edu/dept/soweb/writitem.html
  - The National Board of Medical Examiners
    “Constructing Written Test Questions For the Basic and Clinical Sciences”
    http://www.uab.edu/uasomume/cdm/test.htm
- More item-writing resources here:
  - http://cte.umdnj.edu/student_evaluation/evaluation_constructing.cfm

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Item Development Workshop  
Part II: Creating Test Items to Evaluate Advanced Cognitive and Performance Levels

Presenters:  
Ray Talke  
Minds in Action, Inc.

Premise

- **Purpose of Professional Certification/Licensure**  
  - Validate Standards for competent practice in a profession, occupation, role or skill  
- **Knowledge alone is not sufficient to determine successful performance on the job**  
  - Knowledge does not necessarily imply competent practice  
    - “Paper Credentials”  
  - Competent practitioners may have internalized knowledge components but have difficulty articulating knowledge

The Emerging Environment

- Almost all information is available on demand  
- **Success = Ability to access information as required**  
  - Not necessarily the memorization of information  
- **Success = Ability to apply information to achieve results**
The Memorization/Regurgitation Conundrum

Yet many professional certification and licensure examinations persist in evaluating the memorization of declarative knowledge while minimizing or ignoring how that knowledge is used in the job environment!

- Resulting in the critical and:
  - the Superfluous
  - the Trivial
  - the Irrelevant

The Solution

- Begin with a Strong Foundation
  - Job Role Description
  - Standards
- Assess at Different and Advanced Cognitive and Performance Levels
  - Declarative
  - Procedural
  - Performance

Job Role Description

- Defines the Characteristics of a Credentialed Individual
- Provides a Common Understanding of:
  - Responsibilities
  - Tasks
  - Industries/Geographies
  - Level of Competence
- Used by:
  - Candidates
  - Test Item Writers
  - Consumers/Stakeholders
Job Role Description

- Name/Title of the Job Role
- Typical Industries/Environments Employing Individuals in the Job Role
- Geographic Reach
- Primary Job Responsibilities
- Overall Level of Competence

Levels of Competence

1. The individual possesses a basic familiarity with the conditions and terminology used on the job.
2. The individual is able to describe the characteristics of the job and explain the processes involved in completing tasks on the job.
3. The individual is able to perform the tasks of the job with some assistance from others.
4. The individual is able to perform the tasks of the job with minimal assistance from others.
5. The individual is able to perform the tasks of the job with no assistance from others.
6. The individual is able to perform the tasks of the job with no assistance from others and is considered to be an expert in the field. This individual mentors and advises other members of the profession.

Licenses Hangnail Specialist

Job Role Description

A Licensed Hangnail Specialist is an individual who treats diseases and abnormalities related to hangnails in North American hospitals, clinics and private practices. The Hangnail Specialist is responsible for promoting hand and finger health, identifying hangnail risk factors, diagnosing and treating hangnail-related diseases and performing hangnail surgery. Hangnail Specialists are expected to perform the tasks of their profession with minimal assistance from others.
Job Role Description

Self Assessment

• Does Your Credential have a Published Job Role Description?
• Does it Include:
  - Name/Title of the Job Role
  - Typical Industries/Environments
  - Employing Individuals in the Job Role
  - Geographic Reach
  - Primary Job Responsibilities
  - Overall Level of Competence

Test Standards

Why are Standards Important?

• Define Tasks or Competencies of Individuals in the Credentialed Job Role
• Used to Describe Purpose/Significance/Value of the Credential
  - Define criteria assessed by the certification/licensure examination
  - Let stakeholders know the significance/value of the credential
• Used to Anchor Individual Test Items
• Create a Consistent Understanding of the Job Role and Performance Requirements
• Serve as Validity Benchmarks

Test Standards

Should:

• Clearly Detail Competencies Mastered by Credentialed Individuals
  - Tasks performed on the job
  - Knowledge, Skills and Attitudes
  - Environments/Situations in which Tasks/Competencies are used
  - Required level of performance
• Be Measurable
• Be Clear and Specific
• Be Published and Easily Accessible to Candidates, Employers and other Stakeholders
Types of Test Standards

**Weak**
- No standards
- Content domains
- Task listings
- Terminal objectives
- Enabling objectives (K,S,A’s)
- Combination of Terminal and Enabling Objectives
- Competency / Cognitive levels

**Strong**

Content Domains

- Listing of Subjects or Topics Assessed on the Credentialing Examination
- Standards Often State the Relative Weight of Each Topic Area on the Examination

<table>
<thead>
<tr>
<th>I. Promotion of healthy lifestyle - 6% of test content</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) At risk populations</td>
</tr>
<tr>
<td>b) Risk factors</td>
</tr>
<tr>
<td>c) Effects of hangnails</td>
</tr>
<tr>
<td>d) Prevention strategies</td>
</tr>
<tr>
<td>e) Hand and finger contamination</td>
</tr>
<tr>
<td>f) Nutrition</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>II. Screening and Early Detection - 10% of test content</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Hangnail risk factors</td>
</tr>
<tr>
<td>b) Screening</td>
</tr>
<tr>
<td>c) Early detection</td>
</tr>
<tr>
<td>d) Early symptoms</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>III. Diagnosis - 8% of test content</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Hangnail symptoms</td>
</tr>
<tr>
<td>b) Physical examination techniques</td>
</tr>
<tr>
<td>c) Diagnostic tests</td>
</tr>
</tbody>
</table>

Advantages of Content Domains

- Easy to construct
- Clearly organized into categories of knowledge
- Grants item writers significant latitude
Limitations of Content Domains

- Context of Subjects or Topics not Defined
  - Ambiguous
- Relevance to Job Responsibilities not Established
- Level of Mastery not Defined
  - No Measurement Criteria
- Subjects or Topics are Often Broadly Defined
  - Lack of Specificity
- Tend to Emphasize Memorization of Knowledge
  - Not Application of Skills

Task Listings

- Inventory of Activities Performed on the Job
  - Observable
  - Consist of two or more steps
  - Result in a product, service or decision
- Documented with an Active Verb and Subject
  - May sometimes include a modifier
- Some Task Listings include Subtasks
  - Steps in the process

Advantages of Task Listings

- Congruent to the job
- Clearly define specific activities performed by credentialed individuals
  - Emphasize application of skills
- Provide job context to test item writers
  - Improve validity of test items
Limitations of Task Listings

- Specific knowledge and skill requirements are not defined
  - Test item writers have little guidance of the content of test items.
  - Candidates may interpret knowledge and skill requirements differently than test item writers.
- Level of mastery or completion criteria for task is not defined
  - True competence of credentialed individuals is not known.
  - Test items may be written to inappropriate difficulty levels.
  - Test items may address job environments foreign to the target audience.
- Knowledge and skill requirements may overlap different tasks
  - Duplication of content on tests.

Terminal Objectives

- Declarative Statements Detailing:
  - Environment or conditions under which a task is performed,
  - Description of the task, and
  - Criteria used to validate successful completion or mastery of the task.

I. Given a patient complaining of finger problems, screen the patient for hangnail risk factors so that all conditions that may affect digit health are identified. (10% of examination)

II. Given a live patient or photograph of a patient’s hand, identify all of the symptoms on the patient’s hand that may indicate the early development of hangnails. (17% of examination)

III. Given a patient complaining of finger problems, document the patient’s symptoms and accurately diagnose the disease affecting the patient’s finger. (20% of examination)

IV. Given a patient wanting a finger examination, collect the patient’s medical history so that all of the information required by the American Hangnail Association standard 10.24(a) is documented. (5% of examination)

Advantages of Terminal Objectives

- Strong congruence to the job
- Clearly define specific activities
- Clearly define context in which the tasks are performed
  - Job environment
- Clearly define mastery criteria
  - Establishes difficulty level
Limitations of Terminal Objectives

- More difficult to construct
  - Job context must be fully understood
- Standards are still broadly defined
  - Specific knowledge and skill requirements are not defined
    - Test item writers have limited guidance of the content of test items
    - Interpretation of scope of required knowledge and skills may differ between individuals
- Content may overlap terminal objectives

Enabling Objectives

- Declarative Statements
  - Defining Mastery Requirements for:
    - Knowledge - facts, details, information
    - Skills - psychomotor components of activities
    - Attitudes - values, feelings, appreciations
- Lend Themselves to Objective Assessment
  - Measurable Verbs

1. List the risk factors for hangnails.  (K)
2. Describe the conditions that may affect digit health.  (K)
3. Diagnose the type of hangnail on a patient exhibiting symptoms.  (S)
4. Commit to maintaining a non-judgmental attitude when examining patients with hangnail symptoms.  (A)
5. State the cause of paronychia and describe its symptoms.  (K)

Advantages of Enabling Objectives

- Strong Congruence to Job
- Provide Very Detailed Description of Specific Mastery Requirements
  - Provide specific information as to what is being assessed
  - Provide specific guidance to test item writers
  - Consistent expectations/understanding among all stakeholders
- Address Major Components of Performance
  - Knowledge
  - Skills
  - Attitudes
Limitations of Enabling Objectives

- Balance between knowledge, skill and attitudinal-based objectives may not reflect relative importance of use on the job
- May lose job context if enabling objectives are not linked to task statements or terminal objectives
- Attitudinal objectives may be difficult to objectively assess
- Item writer flexibility is severely restricted
  - Requires true subject matter experts and experienced job professionals

Combining Terminal and Enabling Objectives

I. Given a patient complaining of finger problems, screen the patient for hangnail risk factors so that all conditions that may affect digit health are identified. (10% of examination)
   1. List the risk factors for hangnails. (K)
   2. Describe the conditions that may affect digit health. (K)
   3. List the steps performed when screening a patient for hangnail risk factors. (K)
   4. Commit to maintaining a non-judgmental attitude when examining patients with hangnail symptoms. (A)
   5. Screen a patient for hangnail risk factors. (S)
   6. On a patient exhibiting symptoms, identify conditions that may affect digit health. (S)

Combining Terminal and Enabling Objectives

- Terminal Objectives and Associated Enabling Objectives are Published as Test Standards
- Provides Clear Description of Criteria Used to Award Certification or Licensing Credential
- Provides Clear Focus and Direction to Test Item Writers
  - Test items are written to specific enabling objectives in support of overall terminal objective
- Test Items are Congruent to Actual Job Responsibilities
- Level of Mastery and Assessment Criteria Clearly Documented
- Appropriate Mix between Declarative, Procedural and Performance Test Items
Cognitive/Performance Levels

- Hierarchy of thought and/or performance levels.
- Usually based on a cognitive/performance taxonomy.
  - Bloom’s taxonomy
  - Anderson-Krathwohl variation
  - Simple taxonomy
  - Merrill Variation
  - Others

Cognitive/Performance Levels

- Bloom’s Taxonomy

- Rarely used alone.
- Supplement other anchor types.

1. List the risk factors for hangnails. (K-Remember)
2. Describe the conditions that may affect digit health. (K-Understand)
3. Diagnose the type of hangnail on a patient exhibiting symptoms. (S-Evaluate)
4. Commit to maintaining a non-judgmental attitude when examining patients with hangnail symptoms. (A)
5. State the cause of paronychia and describe its symptoms. (K-Understand)
Advantages of Cognitive/Performance Levels

- Very detailed definition of mastery requirements
- Test items very focused
- Items address full span of the cognitive/performance domain
  - Ensures assessment of higher cognitive/performance levels
- Difficulty clearly defined by cognitive/performance level

Limitations of Cognitive/Performance Levels

- Severely restricts test item writer’s flexibility.
- Relevance to job dependent upon linked anchor types.
- Doesn’t lend itself to attitudinal objectives.

Comparison of Standards Types

<table>
<thead>
<tr>
<th></th>
<th>Job Relevance</th>
<th>Granularity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content Domains</td>
<td>Poor</td>
<td>Poor to good</td>
</tr>
<tr>
<td>Task Listings</td>
<td>Good</td>
<td>Fair</td>
</tr>
<tr>
<td>Terminal Objectives</td>
<td>Excellent</td>
<td>Good</td>
</tr>
<tr>
<td>Enabling Objectives</td>
<td>Fair to excellent</td>
<td>Excellent</td>
</tr>
<tr>
<td>Cognitive/Performance Levels</td>
<td>Varies</td>
<td>Fair to very good</td>
</tr>
</tbody>
</table>
Standards Self Assessment

- Which standards types anchor the test items of your credentialing program?

  - No standards
  - Content domains
  - Task listings
  - Terminal objectives
  - Enabling objectives (K,S,A’s)
  - Combination of Terminal and Enabling Objectives
  - Competency / Cognitive levels

Creating Test Items to Assess True Professional Competences

- Assess at Different and Advanced Cognitive Levels

- Choose a Taxonomy

Benjamin Bloom’s Taxonomy

**Description**

- Using information, critically judging the value of materials or methods as they relate to a specific situation
- Combining different concepts and ideas to create a new whole
- Creating a new idea or concept
- Breaking down information into its component parts
- Recognizing relationships
- Using facts and rules to solve problems
- Understanding and interpreting information
- Recalling or recognizing information

**Typical Verbs**

- **Evaluation**: Select, determine, judge, classify, differentiate, grade, evaluate, rate, estimate
- **Comprehension**: Define, describe, identify, label, list, match, name, recall, select, state
- **Application**: Apply, calculate, choose, construct, demonstrate, explain, predict, produce, propose
- **Analysis**: Analyze, compare, criticize, define, distinguish, evaluate, list, outline
- **Synthesis**: Assemble, blend, build, construct, create, design, develop, formulate, plan, predict, produce, propose
- **Knowledge**: Accept, appraise, assess, arbitrate, criticize, defend, estimate, evaluate, grade, judge, prioritize, rate, recommend, support
Anderson-Krathwohl Variation

Bloom 1956

Create
Evaluate
Analyze
Apply
Understand
Remember

Comprehension
Application
Analysis
Synthesis
Evaluation
Creation

Anderson-Krathwohl 2001

Simple Taxonomy

DESCRIPTION
PERFORMANCE
PROCEDURAL
DECLARATIVE

TYPICAL VERBS

Performing, Building, Calculating
Psychomotor – Perform the task

Analyze, Interpretation, Evaluation, Planning
Describe how to complete the task.

Facts, Concepts, Information, Process Knowledge
What should individuals know?

DECLARATIVE (Static)

Explain, identify, label, list, name, recall, select, state, summarize.

M. David Merrill Variation
(Declarative Levels)

DECLARATIVE (Static)

1. State facts related to the task (recall information).
2. Define task-related concepts and their interrelationships.
3. Describe the sequence of steps that are taken when performing the task, the conditions under which certain steps are taken, and issues to consider when performing the task.
4. Describe the processes that are involved in the performance of the task and explain the rationales for each.

TYPICAL VERBS

Demonstrate, describe, discuss, dissect, explain, illustrate, outline.

Classify, compare, contrast, define, differentiate, group, match, summarize.

Briefly, explain, identify, label, list, name, recall, select, state.
M. David Merrill Variation

(Procedural Levels)

<table>
<thead>
<tr>
<th>PROCEDURAL</th>
<th>TYPICAL VERBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Given a task scenario, explain how to execute the next step in the task.</td>
<td>Assemble, build, compose, construct, create, demonstrate, design, develop, formulate, explain, illustrate.</td>
</tr>
<tr>
<td>9. Determine the appropriate next step, given a task scenario.</td>
<td>Analyze, compare, design, formulate, plan, predict, propose, recommend, state.</td>
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<tr>
<td>8. Given data, plan how you will perform the task or design the product of the task.</td>
<td>Compose, construct, design, develop, diagram, outline, plan, propose.</td>
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<tr>
<td>7. Given different task scenarios, predict the consequences and changes resulting from each scenario.</td>
<td>Appraise, assess, compare, contrast, differentiate, evaluate, estimate, infer, judge, predict.</td>
</tr>
<tr>
<td>6. Given data, evaluate the current conditions and environment prior to performing a task.</td>
<td>Compose, compare, contrast, evaluate, explain, illustrate, plan, propose.</td>
</tr>
<tr>
<td>5. Interpret data related to a given task.</td>
<td>Annotate, classify, conclude, evaluate, explain, interpret, plan, propose.</td>
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<td>4. Given data, plan how you will perform the task or design the product of the task.</td>
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<td>3. Interpret data related to a given task.</td>
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<td>2. Given data, plan how you will perform the task or design the product of the task.</td>
<td>Annotate, classify, conclude, evaluate, explain, illustrate, plan, propose.</td>
</tr>
<tr>
<td>1. Given a task scenario, explain how to execute the next step in the task.</td>
<td>Assemble, build, compose, construct, create, demonstrate, design, develop, formulate, explain, illustrate.</td>
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</tbody>
</table>

M. David Merrill Variation

(Performance Level)

<table>
<thead>
<tr>
<th>PERFORMANCE</th>
<th>TYPICAL VERBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>11. Perform the task, given a scenario.</td>
<td>Assemble, build, calculate, compose, compute, construct, create, design, develop, formulate, operate, perform, produce, use.</td>
</tr>
</tbody>
</table>

Multiple-Choice Item Types

Declarative Test Items

- Evaluate retention of knowledge
- Assess one or more static concepts
  - The answer is constant regardless of the environment
- Ability to use the knowledge on the job is NOT assessed
Multiple-Choice Item Types

Declarative Test Items - Examples:

- What is the capital of Massachusetts?
- What steps are involved in calculating call load?
- Why must the Gunnison pin be installed before securing the Wagner shaft?

Multiple-Choice Item Types

Procedural Test Items

- Evaluate ability to describe the performance of given activities under certain conditions
- Comprehension, analysis, application, synthesis and evaluation of information may be required to correctly answer question
- Correct response is dependent upon environmental variables
  - If the test item scenario changes, the correct response will also change

Multiple-Choice Item Types

Procedural Test Items - Examples:

- The Bailey Gauge displays a value of -17. What does this signify?
- Pressure on the Worthington Meter is displayed as 35 lbs. per square inch, and the flow rate is 38 cc. per second. What must be done before opening the primary flow valve?
- You are planning to build a 3,600 sq. ft. two-level house on a lot containing sandy loam soil. What type of foundation is indicated in this situation?
Multiple-Choice Item Types

Performance Test Items

• Evaluate ability to actually perform given activities under certain conditions
• Evaluate psychomotor processes
  - Performance, calculation, composition, design, production
• Correct response is dependent upon environmental variables
• Limitations of the multiple-choice format
  - Evaluation of motor processes is often relegated to procedural test items

Examples:

- Enter the following 36 data records into the “Yearly Ledger” database. You have 20 minutes to do so, and must maintain a 98% or greater accuracy rate.
- Based upon the following chart listing last year’s sales, calculate the number of Finnegan pins that must be stocked in your warehouse each month to ensure a 96% in-stock fulfillment rate. Assume a demand growth of 7% from year to year.

Steps Involved in Creating Test Items to Evaluate Advanced Cognitive/Performance Levels

1. Choose a taxonomy.
2. Map current test standards (anchor objectives) to their cognitive/performance levels.
3. Assess current standards (anchor objectives) to ensure they address required cognitive/performance levels.
4. Create and/or elevate standards (anchor objectives) as required.
5. Create test items.
6. Review congruence of test items to standards (anchor objectives) and tasks.
Example

Task: Diagnose Symptoms
Terminal Objective: Given a patient presenting a series of symptoms, use this information, coupled with a physical examination, to accurately diagnose the illness or injury.
Enabling Objective: List the symptoms of Grave’s Disease.
Cognitive Levels:
  • Bloom’s Taxonomy: Knowledge
  • Anderson-Krathwohl Variation: Remember
  • Merrill Variation: Level 1: State facts related to the task (recall information)
  • Simple Taxonomy: Declarative

Typical Declarative Test Item

Which is a symptom indicating that a patient may have Grave’s Disease?

A. constipation
B. buzzing in ears
C. sensitivity to cold temperatures
D. swelling of tissues around the eyes

What’s Missing?

We validated that a physician can memorize symptoms of a particular disease....

But What Have We Missed?
Elevating the Anchor Objective (Standard)

Task: Diagnose Symptoms
Terminal Objective: Given a patient presenting a series of symptoms, use this information, coupled with a physical examination, to accurately diagnose the illness or injury.
Enabling Objective: Given a list of symptoms presented by a patient, diagnose the patient’s illness or injury.
Cognitive Levels:
- Bloom’s Taxonomy: Analysis
- Anderson-Krathwohl Variation: Analyze
- Merrill Variation: Level 6: Given data, evaluate the current conditions and environment prior to performing a task
- Simple Taxonomy: Procedural

Procedural Test Item Example

A patient arrives, complaining of chronic fatigue and muscle weakness, loss of appetite and weight loss. Upon further questioning, you find that the patient has experienced nausea and vomiting. Your physical examination has determined that the patient suffers from low blood pressure, which falls further when the patient stands.

These symptoms are indicative of which disease?

A. Lyme disease
B. Addison’s disease.
C. West Nile disease.
D. Tay-Sachs disease.

Elevating the Anchor Objective (Standard)
Part II

Task: Diagnose Symptoms
Terminal Objective: Given a patient presenting a series of symptoms, use this information, coupled with a physical examination, to accurately diagnose the illness or injury.
Enabling Objective: Given a list of symptoms presented by a patient, determine the appropriate physical examination procedures required to diagnose the illness or injury.
Cognitive Levels:
- Bloom’s Taxonomy: Application
- Anderson-Krathwohl Variation: Apply
- Merrill Variation: Level 9: Determine the appropriate next step, given a task scenario
- Simple Taxonomy: Procedural
Procedural Test Item Example

A patient arrives, complaining of chronic fatigue and muscle weakness, loss of appetite and weight loss. Upon further questioning, you find that the patient has experienced nausea and vomiting.

Based upon this information, what procedure would you next perform?

A. Order an EKG for the patient.
B. Take the patient’s temperature.
C. Take the patient’s blood pressure.
D. Order a chest X-ray for the patient.

Hints for Developing/Elevating Anchor Objectives (Standards)

- Examine the task and required performance criteria.
- Choose a cognitive taxonomy.
- Examine each level of the cognitive taxonomy.
- Create test objectives for cognitive/performance levels applicable to the task.
- Use the verb lists for guidance on creating anchor objectives.
- Be specific! Use measurable verbs in your objectives.

Hints for Developing Test Items for Higher Cognitive/Performance Levels

- Evaluate how information is used on the job - not merely the recall of information
  - Why do examinees need to know this information?
  - What should an individual be able to do with this information on the job?
- Create the test item to focus on how the knowledge is applied on the job.
Hints for Developing Test Items for Higher Cognitive/Performance Levels

- Use “real-world” scenarios/case studies as the foundation of test item stems.
  - Problems encountered on the job
  - Processes performed on the job
  - Analysis/decisions/judgments made on the job
  - Deliverables produced on the job

- Focus on the critical, not the trivial
- Key several test items to the same scenario/case study
  - Avoid “hinging”

Hints for Developing Test Items for Higher Cognitive/Performance Levels

Within the scenario/case study:
- Focus on a specific cognitive/performance level
- Be concise
  - Avoid superfluous information
  - Avoid “red herrings”
  - But provide all of the required information
- Use situations relevant to the test-taking population
- Ensure the vocabulary level and jargon is appropriate to the job
  - Avoid “textbook” scenarios/definitions

Hints for Developing Test Items for Higher Cognitive/Performance Levels

- Use information sets or exhibits
  - Statements and information, separate from the item stem, that contain information about the job environment.
- Information sets and exhibits can be used to elevate declarative test items to higher cognitive/performance levels
Example

Declarative test item:

Which groups are protected by Title VII of the Civil Rights Act of 1964 (as amended in 1972)?

Example of Exhibit Use

Procedural Test Item

Acme Corporation Departmental Roster – Information Services

<table>
<thead>
<tr>
<th>Name</th>
<th>Age</th>
<th>Race</th>
<th>Gender</th>
<th>Years of Service</th>
<th>Military Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Bowen</td>
<td>45</td>
<td>Caucasian</td>
<td>F</td>
<td>15</td>
<td>None</td>
</tr>
<tr>
<td>G. Hernandez</td>
<td>32</td>
<td>Hispanic</td>
<td>M</td>
<td>7</td>
<td>Gulf War Veteran</td>
</tr>
<tr>
<td>L. Huffins</td>
<td>67</td>
<td>African American</td>
<td>F</td>
<td>32</td>
<td>Vietnam Era Veteran</td>
</tr>
<tr>
<td>S. Martin</td>
<td>40</td>
<td>Caucasian</td>
<td>F</td>
<td>3</td>
<td>Active Reserves</td>
</tr>
</tbody>
</table>

Using the exhibit displayed above, how many of Acme Corporation’s Information Services employees belong to protected groups, as defined in Title VII of the Civil Rights Act of 1964 (as amended in 1972)?

Hints for Developing Test Items for Higher Cognitive/Performance Levels

After creating the test item:

- Validate its congruence to its anchor test standard (objective)
- Validate its congruence/relevance to the task
- Validate its congruence to the job
- Ensure that proper item writing practices have been observed
Developing Test Items to Assess Advanced Cognitive/Performance Levels

Self Assessment

• How are your test items distributed?
  - Declarative %
  - Procedural %
  - Performance %

• Are your test items relevant to “real world” job responsibilities?
  - Congruent to their anchor standards/objectives
  - Assessing appropriate cognitive/performance level

Summary

• Ensure universal consensus on the target of the credential with a clear and concise job role description
• Create and publish specific and measurable test standards (objectives)
• Anchor your test items to specific test standards (objectives)

Summary

• Limit questions requiring the recall of knowledge to situations in which it is essential that the information be recalled instantly on the job
• Evaluate the application of information in “real-world” job situations
• Choose a cognitive/performance taxonomy appropriate to your environment
Summary

- Map standards (anchor objectives) to their cognitive/performance levels
- Create/elevate standards (anchor objectives) to address cognitive/performance gaps
  - Specific and measurable standards (anchor objectives) yield superior, more congruent test items
- Use “real-world” situations, scenarios and information sets as the basis for test items
- Validate congruence to the anchor objectives, task and job

Presenter

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