Principled Assessment Frameworks

Engineering the Future of Test Development

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May 15th, 2015
The future of testing is:

- Reliably predicting and controlling the difficulty of test items...
Assessment Engineering

• One of a class of principled assessment frameworks
  • Evidence-centered Design (Mislevy), Principled Design for Efficacy (Nichols), Principled Assessment Designs for Inquiry (IERI)

• Comprehensive, model-based view of test development, administration, and scoring

• Offers potential of both theoretical and practical improvements
  • Construct validity, Response processing validity
  • Item development, calibration, and scoring
Components of Assessment Engineering

• Construct Map
  • Visual representation of the score scale
  • Demarcates ordered proficiency claims relative to the scale

• Task Models
  • Aligned with the ordered proficiency claims
  • Each model represents a family of items providing comparable information

• Templates
  • Item rendering blueprints
  • Provide instructions for producing item isomorphs
Components of Assessment Engineering: Accounting Specific Example

- Evaluates, interprets, searches, and analyzes multivariable systems
- Analyzes and interprets relationships between elements of a single system
- Computes multiple values from formulas
- Defines basic accounting concepts

Decreasing Proficiency

### Construct Map

- Task Models
  - Template C1
    - Rendering data
    - Scoring evaluator
    - Task model data
  - Template C2
    - Rendering data
    - Scoring evaluator
    - Task model data
  - Template C3
    - Rendering data
    - Scoring evaluator
    - Task model data
  - Template AA1
    - Rendering data
    - Scoring evaluator
    - Task model data
  - Template AA2
    - Rendering data
    - Scoring evaluator
    - Task model data
  - Template AA3
    - Rendering data
    - Scoring evaluator
    - Task model data
  - Item C1.xxx
  - Item C1.002
  - Item C1.001
  - Item C2.xxx
  - Item C2.002
  - Item C2.001
  - Item C3.xxx
  - Item C3.002
  - Item C3.001
  - Item AA1.xxx
  - Item AA1.002
  - Item AA1.001
  - Item AA2.xxx
  - Item AA2.002
  - Item AA2.001
  - Item AA3.xxx
  - Item AA3.002
  - Item AA3.001

### Task Models

- Apply (audit procedure)
- Prepare (audit documentation)
- Connect (isolate key components)
- Classify (COGS components)
- Compute (multiple values from formulas)
- Calculate (accruals, moderately simple financial statements)

### Item Templates
Defining a taxonomy of skills

• Criteria of a cognitive taxonomy
  • Grain size, relevance, measurable, hierarchical*
  • Revised Bloom’s Taxonomy (Anderson et al., 2001)

• Distilling the requisite skills
  • Cognitive task analysis (CTA)
  • Reverse-engineering
  • Structure of the skills
    • Hierarchical*, distinct, identifiable

➢ Putting it all together
  • Incorporation into test specifications, guidance of practice analysis
### AE: Modified Skill/Content Specification

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Balance sheet (UAS)</td>
</tr>
<tr>
<td>2.</td>
<td>Income statement (UAS)</td>
</tr>
<tr>
<td>3.</td>
<td>Statement of comprehensive income (UAS)</td>
</tr>
<tr>
<td>4.</td>
<td>Statement of changes in equity (UAS)</td>
</tr>
<tr>
<td>5.</td>
<td>Statement of cash flows (UAS)</td>
</tr>
<tr>
<td>6.</td>
<td>Notes to financial statements (U)</td>
</tr>
<tr>
<td>7.</td>
<td>Consolidated and combined financial statements (UAS)</td>
</tr>
<tr>
<td>8.</td>
<td>First-time adoption of IFRS (U)</td>
</tr>
</tbody>
</table>

- Understand disclosure requirements (U)
- Identify information that needs to be disclosed (U)
- Identify defining characteristics of accounting terms (U)
- Categorize/classify cash flow transactions, assets, liabilities, equity (U)
- Prepare adjusted trial balance (A)
- Prepare supporting schedules or worksheets using accounting rules and procedures (A)
- Calculate/transfer main components of financial statement (i.e., net income, total assets-liabilities-equity-cash flow categories) (A)
- Prepare financial statements (A)
- Prepare financial statements by combining information derived from a variety of sources (S)
- Prepare journal entries, worksheets or financial statement for consolidation with intercompany transactions (S)
Related Research

• Item difficulty modeling
  • Diehl, 2004; Embretson, 1998; Embretson and Daniel, 2008; Embretson and Gorin, 2001; Embretson and Wetzel, 1987; Gorin and Embretson, 2006

• Building/incorporating the infrastructure of AE
  • Luecht, 2015*; Luecht, 2013; Luecht, Burke and DeVore, 2009; Burke, DeVore, and Stopek, 2013; Burke and Stopek, 2013; Stopek and Burke, 2013; Burke, Stopek, and Eve, 2014; Furter, Burke, Morgan, and Kaliski, 2015

• Automatic item generation

• Automated test assembly
  • Van der Linden, 2006; Luecht, 1998

• Item family calibrations
  • Sinharay, Johnson, and Williamson, 2003; Glas and van der Linden, 2003; Geerlings, Glas, and van der Linden, 2011
<table>
<thead>
<tr>
<th>Pros</th>
<th>Cons</th>
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<tbody>
<tr>
<td>- Confirmatory, model-based approach to test development</td>
<td>- Extensive planning and preparation</td>
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<tr>
<td>- Strengthens validity argument</td>
<td>- Potential overkill in some assessment settings</td>
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<tr>
<td>- Directed item development</td>
<td>- Increased cost of test development in the short term</td>
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<tr>
<td>- Decreased cost of test development in the long term</td>
<td>- Requires niche experts in test development and modeling</td>
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<td>- Reduced pre-testing demands</td>
<td>- Requires flexibility in pilot testing</td>
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<tr>
<td>- Standard setting/equating</td>
<td></td>
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</tbody>
</table>
Challenges

• Changing existing processes that work
• People are sometimes territorial
• Measurement concerns often follow practical and policy concerns
• Research is ongoing, work in progress
• No off the shelf products exist, must be custom made
• Doesn’t work in every case*

➢ Establishing buy-in
  ➢ Internal and external stakeholders
  ➢ We are saying this will be better, but they need to come to that conclusion on their own.