Alignment, Depth of Knowledge, & Change
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Alignment has been an issue for as many as forty years, dating back to behavioral objectives and mastery-learning.
Factors Evaluating Alignment

- Standards-based Education
- Systemic Reform
- Criterion-Referenced Assessment
- No Child Left Behind (Title I)
U.S. Department of Education Guidelines

*Dimensions important for judging the alignment between standards and assessments*

- **Comprehensiveness**
- **Content and Performance Match**
- **Emphasis**
- **Depth**
- **Consistency with achievement standards**
- **Clarity for users**
<table>
<thead>
<tr>
<th>Assessment Validity</th>
<th>Standards and Assessment Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Content</td>
<td>Breadth and Depth</td>
</tr>
<tr>
<td>Construct</td>
<td>Structure of Knowledge</td>
</tr>
<tr>
<td>Consequential</td>
<td>Fairness and Equitable</td>
</tr>
</tbody>
</table>
Alignment

The degree to which expectations and assessments are in agreement and serve in conjunction with one another to guide the system toward students learning what is expected.
Degree of Alignment

Standards

Assessment

Standards

Assessment

Assessment

Standards

Assessment Items
Five General Criteria

1. Content Focus
2. Articulation Across Grades and Ages
3. Equity and Fairness
4. Pedagogical Implications
5. System Applicability
Specific Criteria

Content Focus

A. Categorical Concurrence
B. Depth-of-Knowledge Consistency
C. Range-of-Knowledge Correspondence
D. Structure-of-Knowledge Comparability
E. Balance of Representation
F. Dispositional Consonance
Tyler’s Behavioral Aspect of the Objectives
(course dependent)

1. Understanding of important facts and principles
2. Familiarity with dependable sources of information
3. Ability to interpret data
4. Ability to apply principles
5. Ability to study and report results of study
6. Broad and mature interests
7. Social attitudes
Bloom Taxonomy

Knowledge  Recall of specifics and generalizations; of methods and processes; and of pattern, structure, or setting.

Comprehension  Knows what is being communicated and can use the material or idea without necessarily relating it.

Applications  Use of abstractions in particular and concrete situations.

Analysis  Make clear the relative hierarchy of ideas in a body of material or to make explicit the relations among the ideas or both.

Synthesis  Assemble parts into a whole.

Evaluation  Judgments about the value of material and methods used for particular purposes.
Marzano’s Dimension of Thinking (Wisconsin DPI) (1989)

- Gathering Information
  Observe, recall, question

- Organizing Information
  Represent, compare, classify, order

- Analyzing Information
  Attributes and components, patterns and relationships, main points, accuracy and adequacy

- Generating Information
  Infer, predict, elaborate

- Integrating Information
  Summarize, restructure

- Evaluating Information
  Establish criteria, verify
Depth of Knowledge (1997)

Level 1  Recall
Recall of a fact, information, or procedure.

Level 2  Skill/Concept
Use information or conceptual knowledge, two or more steps, etc.

Level 3  Strategic Thinking
Requires reasoning, developing plan or a sequence of steps, some complexity, more than one possible answer.

Level 4  Extended Thinking
Requires an investigation, time to think and process multiple conditions of the problem.
Three Methods:

- Common Framework
- Expert Consensus
- Common Criteria
# Content-by-Process Framework

<table>
<thead>
<tr>
<th>Topics</th>
<th>Categories of Cognitive Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measurement &amp; Calculation in Science</strong></td>
<td>Coverage</td>
</tr>
<tr>
<td>The International System</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Mass &amp; Weight</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Length</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Volume</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Time</td>
<td>0 1 2 3</td>
</tr>
<tr>
<td>Temperature</td>
<td>0 1 2 3</td>
</tr>
</tbody>
</table>
Survey of Enacted Curriculum
Mathematics Cognitive Levels

- Memorize
  Recall basic mathematics facts; etc.

- Perform procedures
  Do computational procedures or algorithms; etc.

- Demonstrate understanding
  Communicate mathematical ideas; use representations to model mathematical ideas; etc.

- Conjecture, generalize, prove
  Determine the truth of a mathematical pattern or proposition; write formal or informal proof; etc.

- Solve non-routine problems, make connections
  Apply and adapt a variety of appropriate strategies to solve problems; etc.
Grade 8 Standards from Three States

State A:
The student will use proportions to solve scale-model problems with fractions and decimals.

State B:
Students compute with rational numbers expressed in a variety of forms; they solve problems involving ratios, proportions, and percentages. Use ratio and proportion to solve problems.

State C:
Apply proportional thinking in a variety of problem situations that include, but are not limited to: 1) ratios and proportions, and 2) percents, including those greater than 100 and less than one.
Survey of Enacted Curriculum
English Language Arts Cognitive Levels

- **Recall**
  Provide facts, terms, definitions, conventions; describe; etc.

- **Demonstrate/Explain**
  Follow instructions; give examples; etc.

- **Analyze/investigate**
  Categorize, schematize; distinguish fact from opinion; make inferences, draw conclusions; etc.

- **Evaluate**
  Determine relevance, coherence, logical, internal consistency; test conclusions; etc.

- **Generate/create**
  Integrate, dramatize; predict probable consequences; etc.
Enacted, Intended, and Assessed Curriculum

**Intended—What standards require**

**Enacted—What teachers teach**

**Assessed—What state tests**

- Pre-Algebra
- Geometric Concepts
- Data Analysis, Probability, Statistics
- Measurement
- Properties, Relationships

Activities:
- Memorize
- Understand Concepts
- Perform Procedures
- Analyze Reason
- Solve Number Problems
- Integrate
### Achieve Matrix

**Grade 3 Mathematics Data Analysis and Probability**

<table>
<thead>
<tr>
<th>Obj. #</th>
<th>Text of Objective</th>
<th>A</th>
<th>B</th>
<th>Content Centrality</th>
<th>Type of Performance Centrality</th>
<th>Source of Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.A. 1a</td>
<td>Organize and display data using pictures, tallies, tables, charts, or bar graphs.</td>
<td></td>
<td></td>
<td>81</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10A. 1b</td>
<td>Answer questions and make predictions based on given data.</td>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>20</td>
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<tr>
<td></td>
<td></td>
<td>41</td>
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<td>53</td>
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<tr>
<td></td>
<td></td>
<td>66</td>
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<tr>
<td></td>
<td></td>
<td>69</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Achieve Alignment Criteria

Item-Standard Match
- Content Centrality
- Performance Centrality
- Source of Challenge

Instrument-Standard Match
- Level of Challenge
- Balance
- Range
Expectations for Student Performance

Acquire
- Recall
  - Memorize
  - Recall

Use
- Skill/Concept
  - Perform Procedures
  - Conduct Investigations
  - Demonstrate
    - Explain
    - Investigate

Strategic Thinking
- Demonstrate Understanding
  - Communicate
    - Information

Extended Thinking
- Conjecture, Generalize
  - Prove
  - Analyze
    - Evaluate

Solve non-routine/make connections
- Generate/Create
  - Apply concepts
    - make
    - connections
Which of these means about the same as the word *gauge*?

a. balance
b. measure
c. select
d. warn
A car odometer registered 41,256.9 miles when a highway sign warned of a detour 1,200 feet ahead. What will the odometer read when the car reaches the detour? (5,280 feet = 1 mile)

(a) 42,456.9
(b) 41,279.9
(c) 41,261.3
(d) 41,259.2
(e) 41,257.1

Did you use the calculator on this question?
☐ Yes  ☐ No
121
13
32
+ 34

1) 190
2) 200
3) 290
4) N
This question refers to pieces $N$, $P$, and $Q$.

In Mr. Bell’s classes, the students voted for their favorite shape for a symbol. Here are the results.

<table>
<thead>
<tr>
<th></th>
<th>Class 1</th>
<th>Class 2</th>
<th>Class 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shape $N$</td>
<td>9</td>
<td>14</td>
<td>11</td>
</tr>
<tr>
<td>Shape $P$</td>
<td>1</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>Shape $Q$</td>
<td>22</td>
<td>7</td>
<td>2</td>
</tr>
</tbody>
</table>

Using the information in the chart, Mr. Bell must select one of the shapes to be the symbol. Which one should he select and why?

The shape Mr. Bell should select: ________________

Explain:
# EXAMPLE OF STANDARDS AND DEPTH-OF-KNOWLEDGE LEVELS

## CONTENT AREA: GEOMETRY

<table>
<thead>
<tr>
<th>Mathematics Standard</th>
<th>Depth-of-Knowledge Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State D Grade 8</strong></td>
<td></td>
</tr>
<tr>
<td>VI. Explore transformations of geometric figures.</td>
<td>3</td>
</tr>
<tr>
<td><strong>State B Grade 8</strong></td>
<td></td>
</tr>
<tr>
<td>II. Graph on a coordinate plane similar figures, reflections, and translations.</td>
<td>2</td>
</tr>
<tr>
<td><strong>State A Grade 6</strong></td>
<td></td>
</tr>
<tr>
<td>IV. Investigate and predict the results of transformations of shapes, figures, and models including slides, flips, and turns.</td>
<td>2</td>
</tr>
<tr>
<td>IV.D. Identify and describe the results of translations (slides), reflections (flips), rotations (turns), or glide reflections.</td>
<td>2</td>
</tr>
</tbody>
</table>
Issues in Assigning Depth-of-Knowledge Levels

- Variation by grade level
- Complexity vs. difficulty
- Item type (MS, CR, OE)
- Central performance in objective
- Consensus process in training
- Aggregation of DOK coding
- Reliabilities
Distribution of Depth-of-Knowledge Levels from Different States Language Arts

<table>
<thead>
<tr>
<th>Standard</th>
<th>Number of Objs. Under Standard</th>
<th>DOK Levels of Obj.</th>
<th># of Objs by DOK Levels</th>
<th>% of Objs by DOK Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michigan High School</td>
<td>55</td>
<td>1</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td></td>
<td>2</td>
<td>15</td>
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<td>31</td>
<td>57</td>
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<tr>
<td></td>
<td></td>
<td>4</td>
<td>9</td>
<td>16</td>
</tr>
<tr>
<td>West Virginia Grade 8</td>
<td>32</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>12</td>
<td>37</td>
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<tr>
<td></td>
<td></td>
<td>3</td>
<td>16</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Alabama Grade 8</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>2</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>25</td>
</tr>
</tbody>
</table>
Distribution of Depth-of-Knowledge Levels from Different States Mathematics

<table>
<thead>
<tr>
<th></th>
<th>Total Number of Objectives</th>
<th>DOK Level</th>
<th># of Objs by Level</th>
<th>% within std by Level</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Michigan High School</strong></td>
<td>77</td>
<td>1</td>
<td>9</td>
<td>11</td>
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<tr>
<td></td>
<td></td>
<td>2</td>
<td>41</td>
<td>53</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>24</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td><strong>West Virginia Grade 8</strong></td>
<td>34.25</td>
<td>1</td>
<td>4</td>
<td>12</td>
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<tr>
<td></td>
<td></td>
<td>2</td>
<td>20</td>
<td>62</td>
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<tr>
<td></td>
<td></td>
<td>3</td>
<td>8</td>
<td>25</td>
</tr>
<tr>
<td><strong>Alabama Grade 8</strong></td>
<td>14.75</td>
<td>1</td>
<td>6</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>7</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>
Mathematics DOK Levels for Objectives by Grade

Percent of DOK Levels

Grade

Grade 3
Grade 4
Grade 5
Grade 6
Grade 7
Grade 8
Grade 10

DOK Level 1
DOK Level 2
DOK Level 3
DOK Level 4
Reading Language Arts DOK Levels for Objectives by Grade
Implications of Depth-of-Knowledge Levels for Assessment Development

- Distribution (50% at or above)
- Varies by purpose for the assessment
- Vertical alignment
- Mandates (multiple measures definition)
Vertical Alignment Questions

- What level of *concurrence* is there between objectives for the two grades?
- To what extent do comparable objectives increase in *depth* from one grade to the next?
- To what extent does the *range* of content increase from one grade to the next?
- How does the *balance of representation* change from one grade to the next?
Type of Vertical Relationships

- Broader: The higher-grade standard reflects a broader application of the target skill or knowledge (generalizing from specific to additional applications).

- Deeper: The higher-grade standard reflects deeper mastery of the target skill or knowledge (e.g., application rather than recognition).

- Prerequisite: The lower-grade standard reflects a different, but prerequisite skill for mastery of the higher grade standard.

- New: The higher-grade standard is a new skill or knowledge unrelated to skills or knowledge covered at prior grades.

- Identical: The higher-grade standard appeared to be identical to one of the lower-grade standards.
Tindal’s levels of complexity to rate standards for alternate assessments

- 1 – No clear behavioral dimension is present.
- 2 – Rote behavior chains are identified with very low-levels of complexity.
- 3 – Discrimination behavior is present with choice points for engaging in complex responses.
- 4 – Response classes are described with complex behavioral routines in multiple contexts.
Welcome to Web Alignment Tool

This tool is designed to produce reports on the alignment of curriculum standards and student assessments.

The process requires a group of reviewers first to assign depth-of-knowledge (DOK) levels to standards/objectives (Part I). Then reviewers are to code assessment items by identifying the depth-of-knowledge for each item and the corresponding standard/objective (Part II).

1. The steps in using this tool and the process include
2. Training on DOK levels for content area
3. Logging on
4. Selecting a state, content area, and grade
5. Individually coding DOK for each objective
6. Group reaching consensus on the DOK for each objective
7. Coding independently the DOK for each assessment item and corresponding objective(s)
8. Recording Source of Challenge and Notes
Web Sites

http://facstaff.wcer.wisc.edu/normw/

Alignment Tool
http://www.wcer.wisc.edu/WAT/index.aspx

Survey of the Enacted Curriculum
http://www.SECsurvey.org