Multiple Representations

Procedural Skills Item Formats

Procedural representations specifically apply to standards that reference the verbs including *compute*, *solve*, *identify*, *interpret*, *use*, *make* and *find solutions*. Procedural representations are most often MCQs that require students to apply and identify mathematic processes in various ways.

P) These items are conceptualized so that students:

Pa. Solve problems that involve forward computation, procedures, or process involving

Pb. Solve problems that involve non-forward computation, procedures, or process involving

Pc. Solve problems using numbers organized in different ways (horizontally, vertically in lists, tables)

Pd. Interpret and solve problems requiring the manipulation of numbers among different forms or from one form to another

Pe. Relate or evaluate two or more pieces of information to solve a problem vs. more directed stems not relating multiple pieces of information found within the problem context

Pf. Make or interpret conditional statements: "If... then..." (Student could identify example or create)

Pg. Identify extraneous information

Ph. Identify missing information that is required in order to fulfill claim of stem

Pi. Incorporate new information introduced in stem to information given in accompanying table, graph, or picture

Pj. Find values that make a process/principle/rule or relationship true

Pk. Modify, manipulate, or mark provided graphic to demonstrate concept or respond to claim in stem

Pl. Use provided values to demonstrate a process/principle/rule

Pm. Use symbols as placeholders to capture or emphasize the process/principle/rule

Pn. Recognize repetition of calculations and make use of shortcuts

Po. Illustrate/demonstrate the correct process/principle/rule without calculating the answer (or sets of correct processes/principles/rules)

Pp. Identify and explain errors in procedures

Pq. Relate new information from stem into information given in table or graph

Conceptual Understanding Item Formats

Conceptual understanding representations are applied to standards using verbs including *understand*, *explain*, *represent* **and** *describe*. **The resulting item types require different combined mathematical practices depending on the given item type or item.**

C1) Explanation of Process/Principle/Rule: *These types of items require students to identify or explain a component of math or mathematic understanding. Items that successfully assess conceptual understanding with this type of representation can be formatted in at least the following ways:*

    C1a.   Verbal explanation of process/principle/rule

    C1b.   Verbal explanation of result of process/principle/rule

    C1c.   Verbal description of undoing the process/principle/rule

    C1d.   Identification of missing steps

    C1e.   Show meaning of procedure, strategy, or reasoning process, using examples

    C1f.   Show meaning of procedure using counterexamples

    C1g.   Explain errors in process/principle/rule

    C1h.   Explanation of choice in process/principle/rule

    C1i.   Select the most appropriate strategy to represent information

    C1j.   Undo (*deconstruct*) formulaic strategies

    C1k.   Differentiate between strategies

C2) Patterns and Relationships: *These types of items require students to identify, define, and create patterns and relationships using numeric, abstract, geometric, and graphical information. Item formats that deal with patterns and relationship may include*:

    C2a.   Generate similarities and differences between processes, graphs, tables, and patterns

    C2b.   Draw connections between numerical concepts and geometric scenarios

    C2c.   Explain the relationship between different numerical representations

    C2d.   Discern and articulate patterns represented numerically, graphically, or with symbols

    C2e.   Create patterns from a rule, concept, visual, or verbal description

    C2f.   Make inferences using data

C3. Transforming and Connecting Models*: These items require students interpret between multiple contextualized and decontextualized informational sources. Item formats that deal with transforming and connecting models include:*

    C3a.   Translate between visual models and verbal descriptions

    C3b.   Use visual models to explain and represent numerical concepts

    C3c.   Create problem scenarios that illustrate mathematical concepts, processes, and procedures

    C3d.   Use mathematical processes, principles or rules to verify a model

    C3e.   Justify choice of particular model to fulfill a particular task or model a situation

    C3f.   Classify and organize information

Application Item Formats

Application standards and items are unique within the core. There can be standards that reference applications that are represented by application tasks, and applications tasks that are used to represent standards where application is not explicitly called for. Broadly speaking, application items require students to apply both procedural and conceptual knowledge to complete a task. More specifically, application items require students to:

- make assumptions and simplifications
- model situations
- select appropriate knowledge and processes
- validate answers as reasonable or make generalizations within the problem-solving context

To successfully represent standards that reference application OR represent standards through application, item formats include:

A1. Prediction: Items may require students to make assumptions, select appropriate information, and form conjectures.

A2. Planning: Items require students to organize and select salient information in order to plan and respond to multifaceted demand. Often students will need to simplify the problem and determine the reasonableness of their solutions in the context of the problem.

A3. Proof: These items are intended for students to make assumptions, consider simpler cases of the problem, and construct a logical argument. Items will require students to judge the reasonableness or coherence of their results.

A4. Create Models: Items require students to make assumptions and apply appropriate knowledge and process to create models or problem scenarios.

A5. Solve Models: Items require students to make assumptions and apply appropriate knowledge and process to create solve real-world issue/problems.

A6. Evaluate: Infer truth or fallacy of statements based on outcome of procedures using given and missing information.