

Constructing Common Core Test Items

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## Executive Summary

According to the California Department of Education (2013) state wide student assessments of the Common Core State Standards (CCS) will be implemented in the 2014-2015 school year. The Smarter Balanced Assessment Consortium (SBAC) will be providing the assessments used in California. “As they await more information about the assessment, some districts are doing what they can to get ready for them” (Dessoiff, 2012 p. 57). With new assessments it will take time for teachers and educators to adjust to the different styles of questions.

This instructional event will help prepare mathematics teachers to write SBAC style questions. Mathematics instructors who have been exposed to the CCS are the intended audience of this instruction. There are no special tools required for this instruction; however, this instruction will not be able to support translation the teacher created assessment items in multiple languages to support English Language Learners. An estimated 40 hours will be needed to create, assess, and revise the instructional event for implementation in a professional development setting.

### **Goal Statement**

Mathematics teachers will be able to construct SBAC style questions based on the CCS, identifying the type of question, the conceptual category, domain code, standard number, and associated Standards for Mathematical Practice (SMP).

## **Analysis**

### **Needs Analysis**

The Common Core Standards for Mathematics now requires students to “justify their conclusions, communicate them to others, and respond to the arguments of others” (National, 2010b). Teachers will need to expose students to the new testing and response styles. “The Standards insist that instruction in reading, writing, speaking, listening, and language be a shared responsibility within the school” (National, 2010a). Mathematics educators will need to recognize the new question styles, and create their own questions. Currently available textbooks do not have SBAC styled questions.

### **Learner Analysis**

Mathematics teachers will be referred to as learners or participants throughout the remainder of the document to avoid confusion with the role of the instructor of the professional development. The learners are highly qualified under No Child Left Behind to teach mathematics. It is expected that the teachers will be familiar with the old mathematical content standards, and will know and understand the terms used in the new CCS mathematical standards. Participants should already possess experience and skills in writing test items for their courses. However, the learners will have different levels of knowledge about the CCS, and may lack enthusiasm about the change in standards. Some will be motivated to change their assessments to match the SBAC style questions, while others will be uninterested in changing their long established assessment practices and test items. The instruction will identify a motivating factor for these learners slow to adopt CCS. Training using this design will take place during a paid professional development for the learners. Learners will be chosen to represent their school site and they will be expected to share the instructional outcomes with their colleagues.

Testing new mathematics standards will begin in the 2014-2015 school year, so the learners will find this instruction relevant to their students' success. The attitude will be to improve student learning and test preparation, and the participants will be interested in creating a question bank. There will be a willingness to learn, but only if the learners find the instruction immediately useful. The instruction will allow the learners to return to their classrooms with the knowledge and skills to write their own SBAC style questions; furthermore, the learners will leave with standards based SBAC style questions for the mathematical content of their choice. It is common for there to be group work and sharing out in a professional development setting; the learners will be willing to participate in single or group work, whatever the instruction requires.

**Entry behaviors.** The learners will be expected to have a question item from their class (e.g. an old copy of their chapter test). Participants are expected to have had some exposure to the CCS for Mathematics; however, learners will not have to have the CCS memorized. An ability to recognize the concepts they teach in the content standard descriptions in the CCS is expected. Learners are also expected to have a familiarity with writing test items and the ability to identify mechanics of questions. The learners are mathematics teachers that are considered highly qualified and are able to evaluate in instructional documents like test items.

### **Context Analysis**

The instruction will take place in a classroom, with learners sitting at tables of varying sizes. The room will have limited, or no, Wi-Fi connectivity. Learners may have their own laptops, but not all will have a site issued device. Writing utensils, paper, or any materials needed for group work will be available.

This will match the learner's work environment because the instruction isn't a lesson on instructional strategies, but how to prepare assessment materials for the participants' classes or site. Participants in the instruction will not necessarily be limited to grade level bands due to a limit a school site's staffing needs. It is very likely that many grade level teachers will be present. The learners will have the resources common to the profession including a copy of the Common Core Standards for Mathematics. A copy of the CCS can be loaned if the learners do not have their own, though the CCS are available online which all learners will be able to access at their school sites.

### **Task Analysis**

Below is a list of the main goals of the instruction, with each sub skill listed.

1. Identify conceptual category, domain, and standard number of test items.
  - 1.1. Use the Common Core Standards for Mathematics.
    - 1.1.1. Identify the conceptual category and domain code from the CCS.
    - 1.1.2. Identify the standard number that represents a concept.
2. Identify Standards for Mathematical Practices to assess in the test item.
  - 2.1. Verbally identify the Standards for Mathematical Practice in the Common Core Standards for Mathematics.
    - 2.1.1. Distinguish elements of the SMPs.
3. Create a SBAC Style Question
  - 3.1. Determine the appropriate SBAC question type for a concept.
    - 3.1.1. Verbally Identify the SBAC question types.
    - 3.1.2. Verbally identify the key elements of the SBAC Question types.
4. Evaluate peer's test item.



**Learning Objectives**

1. Learners will deconstruct, as a group, key elements of SBAC example items based on the type of question. Learners will verbally identify these deconstructed elements of the example items, a list will be written by the instructor for future reference and evaluation. Cognitive Domain, Analysis Level.
2. Learners will, in a small group, identify the conceptual category and domain code of a SBAC example item and write it in the adjacent chart. They will use the CCS as a resource. Cognitive Domain, Knowledge Level.
3. Learners will, in a small group, identify the standard number of a SBAC example item and write it in the adjacent chart. They will use the CCS as a resource. Cognitive Domain, Knowledge Level.
4. Learners will, in a small group, identify the SMPs associated with a SBAC example item in the adjacent chart. They will use the CCS publication as a resource. Cognitive Domain, Knowledge Level.
5. Using the concept from their current class, learners will classify the conceptual category and domain of the concept using the CCS. Learners will record the information on the New Test Item form. Cognitive Domain, Comprehension Level.
6. Using the concept from their current class, learners will classify the standard number of the concept using the CCS. Learners will record the information on the New Test Item form Cognitive Domain, Comprehension Level.



7. Learners will select an appropriate SBAC question category for the item they will create; participants will identify the category on the New Test Item form. Cognitive Domain, Analysis Level.
8. Learners will select the key elements of the question category most appropriate for their concept and question type; the chosen key elements will be recorded on the New Test Item form. Cognitive Domain, Analysis Level.
9. Learners will select the appropriate SMPs the test item will emphasize, recording the choice on the New Test Item form. Cognitive Domain, Comprehension Level.
10. Learners will generate a SBAC style question using their chosen concept on the New Test Item form based on the results of objective 8 & 9. Cognitive Domain, Synthesis Level.
11. Learners will evaluate another participant's New Test Item form, checking that the choices of conceptual category, domain, and standard number of the concept are justified. The learner will also assess if the associated SMPs are appropriate. When evaluation is complete the learner will initial in the Peer Review box, and leave any necessary comments. Cognitive Domain, Evaluation Level.

## **Design**

### **Assessment Items**

Objective 1 will be assessed by the instructor, who will elicit verbal response from participants who will identify key elements of the SBAC style questions. Examples of some of the key elements the learners should identify for each category are listed in appendix A. Success will be measure by the judgment of the instructor that an appropriate number of key elements were identified to use in constructing new test items.

For objectives 2, 3, and 4 learners will be asked to fill out the appropriate parts of a form that has an SBAC style question and space to record the conceptual category, domain code, standard number, and the SMP. An example of a form can be found in appendix B. The instructor will evaluate the learning by comparing an answer key to what the groups verbally share out in a jigsaw activity.

To evaluate objectives 5 through 11, learners will be asked to complete the New Test Item form as seen in appendix C. The learners will record their selected responses to each of the objectives' task. Participants will be evaluated by a peer, who will approve the New Test Item if a SBAC style question meets the group's criteria determined in objective 1, this is the summative evaluation of the instruction.

### **Instruction**

**Learning theory.** Learners participating in this professional development are experienced math teachers. The instruction concludes by creating a new assessment item and evaluating a peer's work, which is a constructivist learning theory. Dick, Carey, & Carey characterize constructivist learning to have "authentic assessment" and peer evaluation (2009, p. 191). Since most of the learning takes place within a peer group, there is an important social aspect to the learning theory. Having learners identify, discuss, and decide what elements of the SBAC style questions they find important will support the community of teachers in the learner group. Participants might only identify aspects of the SBAC style questions they would like their department to focus on, which represents social constructivism.

**Instructional strategy.** The instruction strategy will follow Gagne's nine events (Dick, Carey, & Carey, 2009. p.171), modified to repeat some events to allow for checking the understanding of the learners as objectives are completed. A quick description of the instructional steps, and the work involved in each step are as follows:

1. The instructor will gain the attention of learners having them solve new SBAC example items in a work packet. The items will be selected to show the key elements of each kind of SBAC question type. (5 minutes)
2. Inform the learners that by the end of the course they will have a SBAC style question to use in their class, and they will be able to create more for any summative benchmark exams. Also, they will be able to evaluate SBAC style questions. (~1 minute)
3. Prerequisite materials will be identified as a list of tools that they will need to be familiar with. These tools will include familiarity with the Common Core Standards and the Standards for Mathematical Practice, along with experience with old test items, and a concept from their class or old test item. Any learner with no experience with the CCS and SMP will need to be identified by the instructor to scaffold appropriately. If the learner did not bring an old test item the instructor will see if any learners brought extra. (5 minutes)
4. The learners will then hold a discussion of the unique features of the SBAC questions items. Creating, as a class, a list of the key elements of each of the question types that they will use throughout the lesson. (5-10 minutes)

5. Then they will be guided through the process of identifying the conceptual category, domain, and standard number for one of the SBAC example items in the work packet. (2-3 minutes)
6. The instructor will then give appropriate time for learners to work in small groups to identify the conceptual category, domain, and standard number for another of the SBAC example items. Each group will work on a different example item from the packet. (5-10 minutes)
7. Since the groups each worked on a different example item, learners will share out their results in a jigsaw exercise. (10 Minutes)
8. The instructor will then guide the learners through the process of identifying the SMP of one of the SBAC example items. (2-3 minutes)
9. The instructor will then give appropriate time for learners to work in small groups to identify the SMP of a different SBAC example items. (5-10 minutes)
10. Again, as a jigsaw exercise, the learners will share out their results for peer feedback. (10 minutes)
11. The instructor will model how to use the New Test Item form, using a predetermined concept. (10 minutes)
12. Using the concept or old test item the learner brought with them, the learners will be given time to complete the New Test Item form. (10-20 minutes)

13. Learners will evaluate a test item that one of the classmates created, making sure that the appropriate conceptual category, domain, standard number were chosen. Also, learners will evaluate if the associated SMPs match the SBAC question type they chose. (5-10 minutes)

**Instructional materials.** Material, media, and tools that will be required for this instruction include:

- Copies of the Common Core Standards for Mathematics; if the learners do not have their own available.
- Example topics or old test items for learners to use if they did not bring their own.
- Stapled packets that include: at least 6 examples of SBAC style questions, and at least 3 blank New Assessment Forms. At least one new assessment item form that should not be used during the instruction so learners can use it at their job site.
- White board for instructor, with appropriate writing utensils.
- Easel, and easel paper.
- Writing supplies and utensils for learners (highlighters, pencils, sticky notes, etc.).

### **Development**

#### **Materials.**

To complete the instructional design the following materials will be needed:

- SBAC Sample items from their website
- Original sample items created by SME
- Assessment Item Form
- All instructional materials not listed (writing utensils, easel, etc.)

- Construction of packet materials.

### Time Table

To complete all the elements for the instruction the following time allotments are suggested:

Description of Task	Hours
Research SBAC Sample items. SME create original sample items for packet. There should be at least 6 items; however, multiple examples of each type, across the topics, would be best.	4-8
Create assessment forms, clear with SME.	2
Create forms for formative evaluations.	4
Copy and collate packets for instruction, after cleared by SME.	6
Procure instructional materials (if not already available at site).	2
Formative Evaluations.	12
Revision of materials and instruction based on the formative evaluations.	6

### Costs and Process

Costs to develop the instruction is limited to the time of the SME (unknown dollar value) and the cost of copying and collating materials (\$100, scalable to size of group). The process to develop the instruction would be as follows:

1. Contact SME, discuss the sample items. Particularly the quantity, types, topics, and preferred delivery method.
2. SME creates and delivers sample assessment items.

3. ID creates the “New Assessment Item Form” and the modified version to use as the assessment tool in the instruction. Clear forms with SME.
4. Create example packet for inspection by the SME.
5. After example packet is cleared by SME, copy and collate the materials for the number of attendees of the formative evaluations.
6. One-to-one formative evaluation.
7. Revisions based on observations and interviews.
8. Small group formative evaluation.
9. Revisions based on observations and evaluation responses.
10. Field trial formative evaluation.
11. Final revisions on observations and evaluation responses.

## **Implementation**

### **Delivery**

The purpose of the designed instruction is to teach mathematics instructors how to create questions similar to SBAC style questions for use on their assessments. This instruction is designed as a district wide professional development for a mathematics department at a public school. Instruction can be delivered in approximately 1 ½ to 2 hours, with limited materials and resources.

### **Formative Evaluations**

The one to one formative evaluation of the instruction would use selected learners. One would be an experienced teacher with a moderate understanding of the CCS. There would also need to be an inexperienced teacher with moderate understanding of the CCS. Finally an



experienced teacher with little to no understanding of the CCS. Each learner represents two important aspects of the entry skills, teaching experience and understanding of the CCS. The instructional designer and Subject Matter Expert (SME) will be able to make inferences on the importance of teaching experience versus understanding of the CCS. Though the sample size is small, the result will allow the designer to revise the instruction going into the small group formative evaluation. The designer and SME will ask the learners specifically about the academic vocabulary, sequence of instruction, clarity of directions, satisfaction with skills learned, and motivation. Since so much of the instruction is dependent on group learning, the one-to-one should focus more on the instructional materials and less on the pacing of the instruction.

The small group formative assessment will focus on the timing of the group activities. Since the instruction is designed for a professional development so using the same room for the small group evaluation would be considered. The size of the group should be 6 people, so as to create 2 groups of 3. The formative assessment items on the end of session evaluation should address: appropriate time given for the tasks, was the final product something the learner could use, could the learner write their own assessment items outside the instruction. The designer would also have an observer that would note the kinds of questions asked during the instruction. Whether questions are asked about the content of the procedure of the instruction can inform the designer and SME on possible revisions for the field trial.

The field trial would use members of the secondary mathematics departments in a school district. If the field trial can be successful within one school district it is likely to have success with only slight modification for new learners in a different district. The instruction could take

place inside a board room, or facility that represents many locations where a professional development would take place. An observer would note the timing, engagement of learners, and the level of success the learners demonstrate the learning objectives. Part of the instruction is for learners to not only create their own assessment item, but to evaluate a peer’s item. The observer could collect and copy the items that were created for evaluation by the SME, the original assessment items would be kept by the learners. Since the learners will be receiving feedback from their peers, there would be no need for the SME or instructor to give the learners feedback after the instruction, though there may be opportunities for the district to supply the math departments with the results. The evaluation of the delivered product would allow the designer and the SME to revise content before the final implementation.

**Appendix A**

An example of the key elements learners may deconstruction from SBAC example items.

Concepts and Procedures	Problem Solving	Communicating Reasoning	Modeling and Data Analysis	Performance Task
-Multiple questions from one stem. -Grouping items. -Matching or moving. -Check box or True/False.	-Typed response. -Explain reasoning. -Asked a direct question.	-Typed response -Given a direct task, no direct question is asked. -Explain your reasoning. -Given two or more reasoned solutions, choose which to support.	-Typed response - Given an open ended question, justify your solution.	- Classroom activity, instructor driven. -Student tasks -Lots of resources and time.

**Appendix B**

Example worksheet for recording conceptual category, domain code, standard number, and SMP.

Concept and Procedures Example Item

**42906**

- A. Drag into the box exactly three unique expressions whose sum is less than 10.
- B. Drag into the box exactly three unique expressions whose sum is between 10 and 20.
- C. Drag into the box exactly three unique expressions whose sum is greater than 20.

$5\sqrt{7}$

$\sqrt{13}$

$\frac{3^8}{3^6}$

$20 - \sqrt{20}$

$(4-2)^{-\frac{1}{2}}$

$8^{\frac{1}{3}}$

**A. Three unique expressions whose sum is less than 10**

**B. Three unique expressions whose sum is between 10 and 20**

**C. Three unique expressions whose sum is greater than 20**

Conceptual Category and Domain Code			
Standard Number			
Standards for Mathematical Practices			
1	2	3	4
5	6	7	8

Figure 1 A worksheet object created using a screenshot of a SBAC example item. (Smarter, 2012)

**Appendix C**

New Test Item form:

**New Test Item**

Concept you are testing: \_\_\_\_\_  
 \_\_\_\_\_

Test Item: \_\_\_\_\_

Conceptual Category and Domain Code			
Standard Number			
Standards for Mathematical Practices			
1	2	3	4
5	6	7	8
Peer Review: _____			

<input type="checkbox"/> Concepts and Procedures <input type="checkbox"/> Problem Solving <input type="checkbox"/> Communicating Reasoning <input type="checkbox"/> Modeling and Data Analysis <input type="checkbox"/> Performance Task
Key Elements:

*Figure 2 A worksheet object used to create new test items.*

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