Developing and Validating Assessments to Measure and Build Elementary Teachers' Content Knowledge for Teaching about Matter and Its Interactions within Teacher Education Settings

Project Overview

This project aims to conduct foundational research and development work related to the assessment of content knowledge for teaching (CKT) about matter and its interactions, as well as supporting the development of this CKT in teacher education settings.

This is a collaborative initiative between ETS and Western Washington University (WWU).

This poster focuses on Project Goal 2 , which refers to developing an instrument to measure CKT for matter and its interactions and evaluating the assessment's validity, dimensionality, and reliability.

CKT Assessment Framework

Work of Teaching Science (WOTS) Instructional Tools

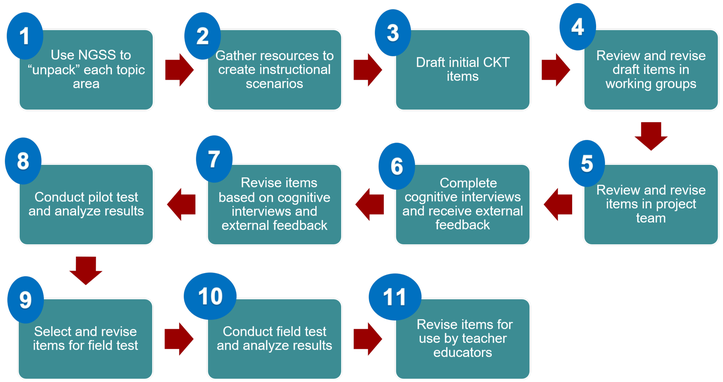
	Instructional goals, big ideas and topics	Scientific investigations & demonstrations	Scientific resources	Students' ideas	Scientific language and discourse	Scientific explanations	Scientific models & representations
Materials							
Properties of matter							
Model of matter							
Changes in matter							
Conservation of matter							

Assessing teachers' ability to evaluate instructional resources that assess student understanding about examples of matter

Assessing teachers' ability to support students in developing scientific arguments using evidence from investigations to establish that matter cannot be created or destroyed

Each of the CKT matter items we developed lives at the intersection of one matter topic and one work of teaching science instructional category.

Item Development Process



Field Test

- The CKT matter assessment form included 60 CKT matter items and was field tested with 822 preservice elementary teachers.
- Based on results from the item analysis, the final version of the CKT assessment included 52 items.
- Preservice teacher scores on the CKT assessment showed moderate correlations to other measures (e.g., *Praxis*® Science Assessment and AIM Horizon Test).
- Analysis suggested that a unidimensional model best supports the assessment's internal structure.
- Reliability of the CKT assessment was high for the unidimensional model (0.911).

CKT Item Examples Focused on Matter and Its Interactions

Item A: Snap Blocks

During a unit on matter, Ms. Johnson asks her second-grade students to take apart a cube made of snap blocks pieces (see image 1) and examine the number and color of the pieces.

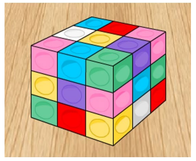


Image 1

Students are then asked to use all the pieces to make something new. After all students create their own object, they look at one another's objects (see image 2). Ms. Johnson guides students to recognize that the number and color of the pieces in the new object remain the same as they try to identify what the object is. Finally, the class has a whole-group discussion that focuses on the potential of a new object being created from the original cube and the wide variety of objects created from the same starting cube.

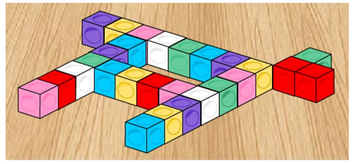


Image 2

Which of the following concepts about matter does this lesson best support at a second-grade level of understanding?

1. Matter can undergo changes that are reversible.
2. Matter can be described by observable properties.
3. Materials have properties that make them suitable for different purposes.
4. Matter is made of small particles that can be arranged in different ways.

Item B: Liquid Definition

In Ms. Quintana's second-grade class, students explore the properties of different solids and liquids. Based on the exploration findings, students create definitions for solids and liquids.

While completing the definition for liquids, one student makes the claim that "all substances that look like they take the shape of their containers are liquids." Ms. Quintana is planning to include a follow-up activity for students to collect more data and refine their ideas.

Which TWO of the following materials will best challenge this claim and help the student improve his definition?

1. Maple syrup
2. Ice block
3. Salt
4. Milk
5. Rice

Score Report for Teacher Educators

- A score report was developed to support preservice teacher educators in identifying strengths and areas for improvement of preservice teachers' CKT performance and making formative decisions.
- The score report included individual and aggregated information of preservice teachers' performance on the CKT matter assessment and links to sample CKT matter items and instructional materials.
- We conducted a usability study with seven elementary science teacher educators to evaluate the utility of the report.

CKT SCIENCE

	Pretest		Posttest		Gain Score Posttest - Pretest		Performance Levels	
Pre-Service Teacher (PST)	Score [265-335]	Standard Error of Measurement (SEM)	Score [265-335]	Standard Error of Measurement (SEM)	Post - Pre	Standard Error of Measurement (SEM)	Pretest	Posttest
Buckner, Callie	280	4	293	3	13	5	Low	Low
Cox, Lillie-Mai	284	3	290	3	6	4	Low	Low
English, Kaisha	295	3	299	3	4	4	Med	Med
Foreman, Harris	297	3	302	3	5	4	Med	Med
Lees, Anwar	299	3	303	3	4	4	Med	Med
Castillo, Malcolm	300	3	304	3	4	4	Med	Med
Rojas, Sharon	303	3	303	3	0	4	Med	Med
Knapp, Bianca	304	3	308	3	4	4	Med	High
Solis, Kylie	304	3	309	4	5	5	Med	High
Patton, Cassie	305	3	307	3	2	4	Med	Med
Bright, Hadassah	307	3	313	5	6	6	Med	High
McDonald, Jenny	307	3	308	3	1	4	Med	High
Montes, Pedro	307	3	315	5	8	6	Med	High
Shaw, Gavin	307	3	310	4	3	5	Med	High
Russell, Jaxon	315	5	317	6	2	8	High	High
Truong, Lea	317	6	315	5	-2	8	High	High
Allen, Aaliyah	323	10	335	16	12	19	High	High
Wilkerson, Naomi			317	6				High
Class Average	303	4	308	5	5	6		

Note: Preservice teacher names are pseudonyms

Project Implications

- This newly-developed CKT assessment, along with teacher educator instructional support materials, can be used in teacher education settings to measure and develop elementary preservice teachers' CKT about matter and its interactions.
- It is possible to make an automatically scorable CKT assessment in science.
- Similar studies could be conducted in other content areas in science and mathematics.

Project Team

- Jamie Mikeska (PI)
- Katherine Castellano (Co-PI)
- Dante Cisterna (Researcher)
- Jennifer Lentini (Project manager)

Visit:

http://cktscience.org

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