A Cognitive Interview Protocol for Assessing Changes in Teacher Knowledge

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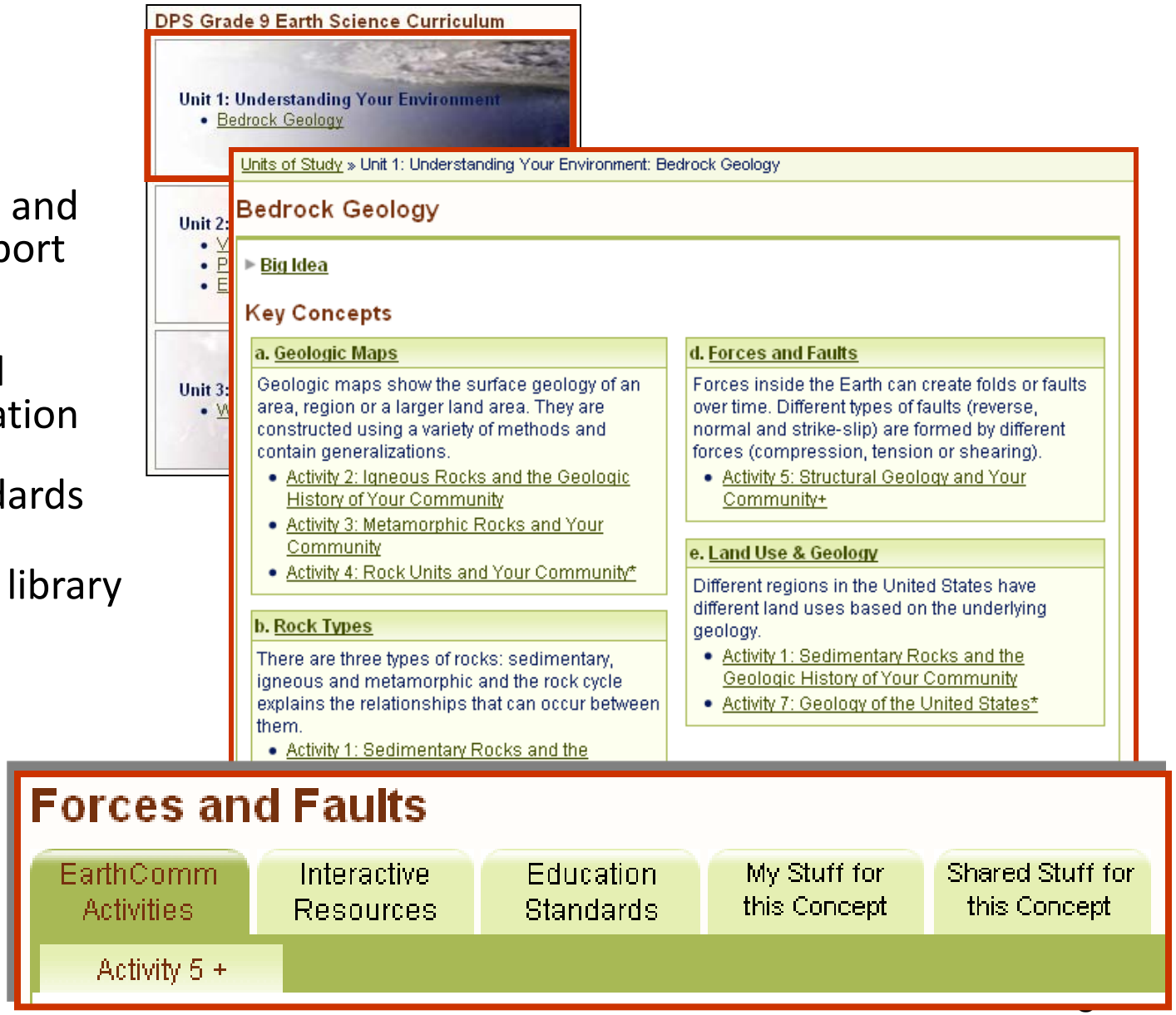
Curriculum Customization Service

- Supports teachers to mix and match materials
  - Customize instruction for **diverse** learners
  - Engage **digital** learners
  - Meet district and state **learning goals**
- Provide one-stop-shopping access to materials teachers need and use
- Support professional development and collegiality through sharing of materials, pedagogy, practice

Curriculum Customization Service

Transforms print materials into interactive, self-directed curriculum guides

- Concept-focused
- Student Activities and Instructional Support Materials
- District scope and sequence information
- Educational Standards
- Interactive digital library resources for differentiation
- Collections of "My Stuff" and "Shared Stuff"



Cognitive Interview: Goals

- **Gather rich, qualitative data** about teachers' knowledge of and approaches to:
  - Curriculum Customization/Differentiation
  - Domain Knowledge & Pedagogical Strategies
  - Use of Technology in the Classroom
- **Analyze interviews using rigorous, cognitively-based methods** to understand potential impact.
  - E.g., Does teacher knowledge change with CCS use?

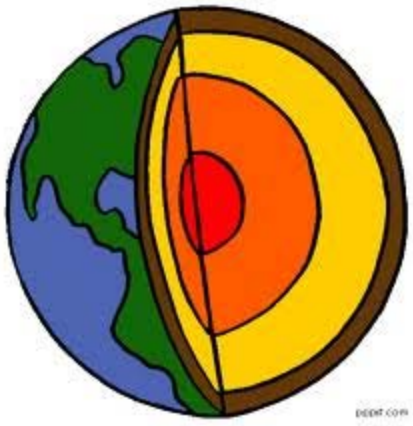
Cognitive Interview: Challenges

- Is **not a "test"** of teachers (and shouldn't be perceived that way)
  - Important to encourage teachers to talk about content and not feel evaluated
  - Need to get teachers to talk about a range of key concepts
- **Focus conversation** on pedagogical practices, science knowledge, curriculum customization, and technology in instruction

Context of Interviews

- DPS Benchmark Exam Items
  - Target key curriculum concepts
  - Focus on curriculum objectives (learning goals)
  - Multiple Choice & Short Answer

Example Assessment Objective:
Seismic evidence explains the different layers of the Earth



How do different types of seismic waves interact with the layers of the earth shown in the diagram at the left? Explain your answer.*

*Not an actual item from the Benchmark Exam (test items are not published for public use).

Final Protocol: 3 Key Dimensions

Science Content

Pedagogical Approaches

Customization

Final Protocol: 3 Key Dimensions

Science Content

- What earth science knowledge would a student need to answer this question correctly?

As you can see, the assessment objective is ----------.

- What earth science knowledge does a student need to understand this concept?
- Are there any common misunderstandings you see related to this concept?

Pedagogical Approaches

Customization

Final Protocol: 3 Key Dimensions

Science Content

Pedagogical Approaches

- What are the most effective lessons, activities, or specific materials that you use in your class to target the idea(s) being tested by this item?
- Are there lessons that are related to this concept, even if they don't specifically target it?

Customization

Final Protocol: 3 Key Dimensions

Science Content

Pedagogical Approaches

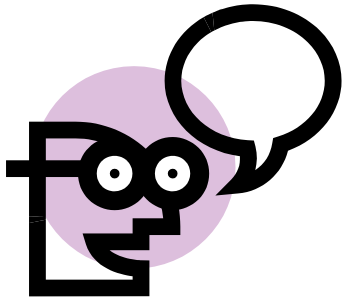
Customization

- In your experience, are there particular students or groups of students who have trouble with the concept being tested by this item?
- Do you have any specific materials or activities that you roll out when you sense that students need to gain a better understanding of this idea/concept?

Participants

- 11 practicing teachers
- 9th grade Earth Science
- Average 8 years teaching in district (range 1-24)
- 2 interviews – early and late in the school year
  - Each interview covered **same 3 science topics**

Cognitive Interview: Verbal Report



- Verbal reports provide critical **insight into cognitive processes** (Ericsson & Simon, 1993)
- Verbal analysis **quantifies *cognitive content*** in participant utterances (Chi, 1997)
- **Verbal utterances track depth of knowledge** when utterances are coded according to cognitive processes (e.g., Butcher, 2006)

Verbal Protocol Analysis

- Well-established, rigorous methodology to quantify rich, qualitative data (Chi, 1997)
  - Interviews **transcribed** verbatim
  - Transcripts **segmented** into idea units
  - Idea units **coded** into cognitively-informed categories
- Interactive Code Development
  - Theory-based codes → apply to sample → test interrater reliability → revise coding definitions → apply to sample → test interrater reliability

Cognitive Coding Scheme

- Drawn from **comprehension theory** (e.g., Kintsch, 1998)
  - Deep processes include prediction, analysis, inference, integration
  - Shallow processes include paraphrasing, memorization
- Reflect **target teacher knowledge**
  - E.g., Customization approaches
    - Target Audience? Prior knowledge? Etc.

Coding Structure

Level 1 Codes: General Categories of Processes/Approaches

[P] Pedagogical Strategies

[S] Science Content Knowledge

[D] Differentiation/Customization

[T] Technology Use in Instruction

10

Level 2 Codes: Categories of Application

[P1] Deep Pedagogical Strategies

[P2] Shallow Pedagogical Strategies

28

Level 3 Codes: Specific Instances/Examples

[P1.1] Prediction

[P1.2] Explaining/Observation

Etc.

90

[P-PedagogicalStrategies] Pedagogical Content Knowledge This category refers specifically to teachers' knowledge about teaching strategies for earth science and to their specific teaching approaches for earth science concepts.

[P1-DeepCogProcesses] Pedagogical/instructional strategies or stated instructional goals that either are targeted to deep student learning outcomes, or make use of deep learning processes during the implementation of the strategy. Subcategories can refer to teaching processes or to student processes during instruction.

[P1.1-Prediction] Comments referring to teaching strategies or instructional goals that make use of (or target) prediction or inference during student learning. This may include predictions about hands-on experiences, student responses to deep questions, etc.

[P1.2-Explaining/Observing] Comments referring to teaching strategies in which the teacher explains concepts, or instructional strategies that prompt students to observe or explain. This may include making or explaining observations, explaining concepts, making presentations in which student explain content, etc.

[P1.3-Visualization/SpatialThinking] Comments referring to instructional goals related to visualization ability (i.e., they need to be able to visualize plates moving) or spatial abilities (i.e., they need to be able to take different spatial viewpoints – over and under the object). Also may refer to instructional methods in which visualization/spatial thinking are central, or to the use of instructional materials that are visual in nature (e.g., diagrams or graphic organizers). Do not code this category if the goal of instruction is shallow (e.g., vocabulary knowledge)

[P1.4-Compare/Contrast] Instructional strategies in which students compare/contrast ideas or the teacher compares/contrasts ideas during teaching (e.g., "The water cycle is a cyclical process just like the rock cycle …"), or when analogies are used by teachers or students to teach/learn

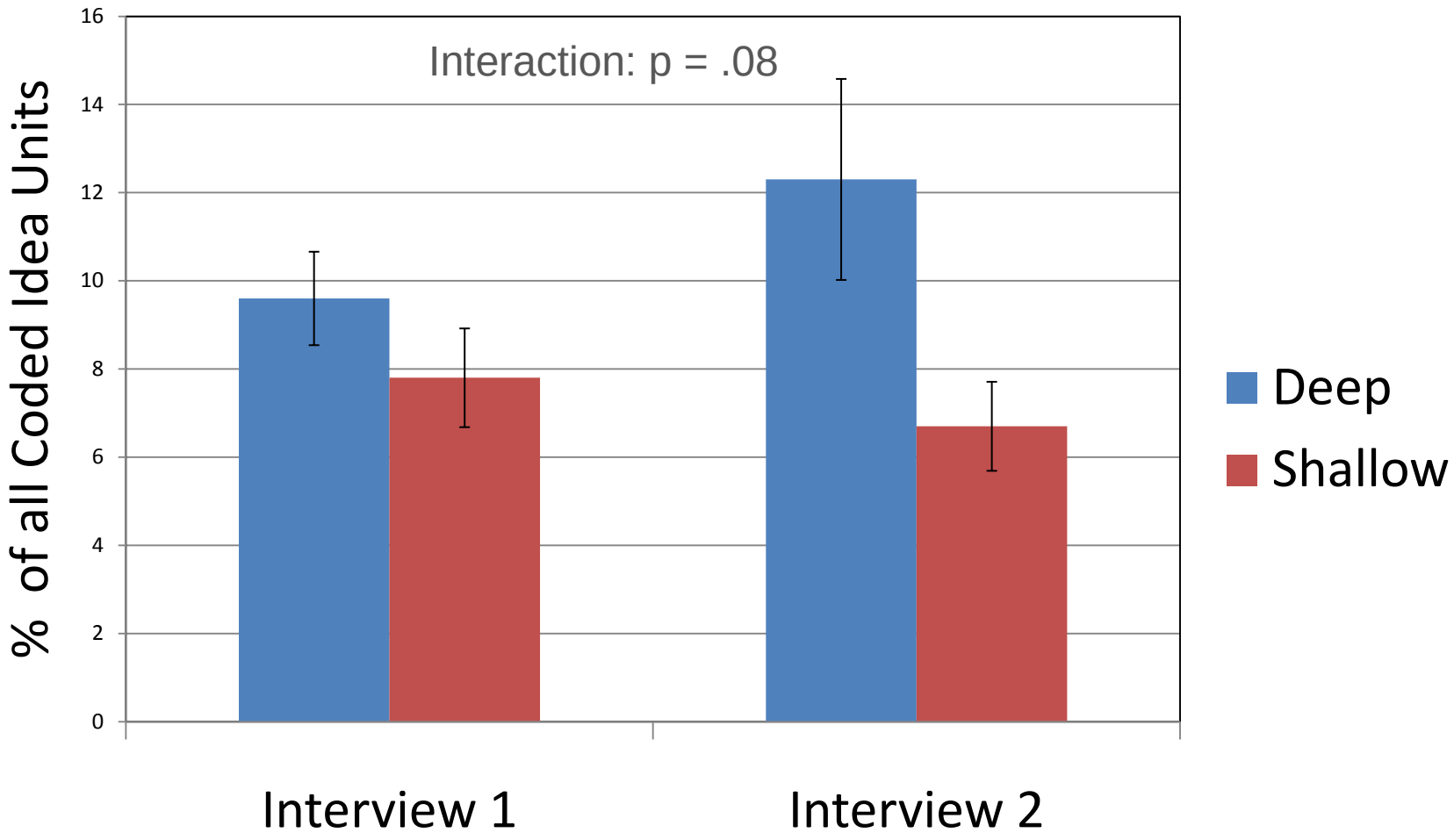
Pedagogical Strategies		
	Deep Cognitive Processes	•"[students] build a map of what they think Pangaea might have looked like, um, based on information they're given in the book" [1] •"[students] make … ocean circulation posters where they explain with pictures and words both the deep circulation and the surface circulations of the oceans" [6] •"Um, I try and work on, um, predictions, um, asking questions that are open ended that may have a couple of different answers" [4]
	Shallow Cognitive Processes	•"And, um, so we use a lot of …worksheets, um, that are on the website for you … you know, just to reinforce, again." [3] • "…instead of having like the whole sentence and everything on the screen, they write, you know, fill-in-the-blanks" [6] •"to answer the question correctly, all they'd need to do is memorize it if we happen to go over it in class" [9]

Interrater Reliability

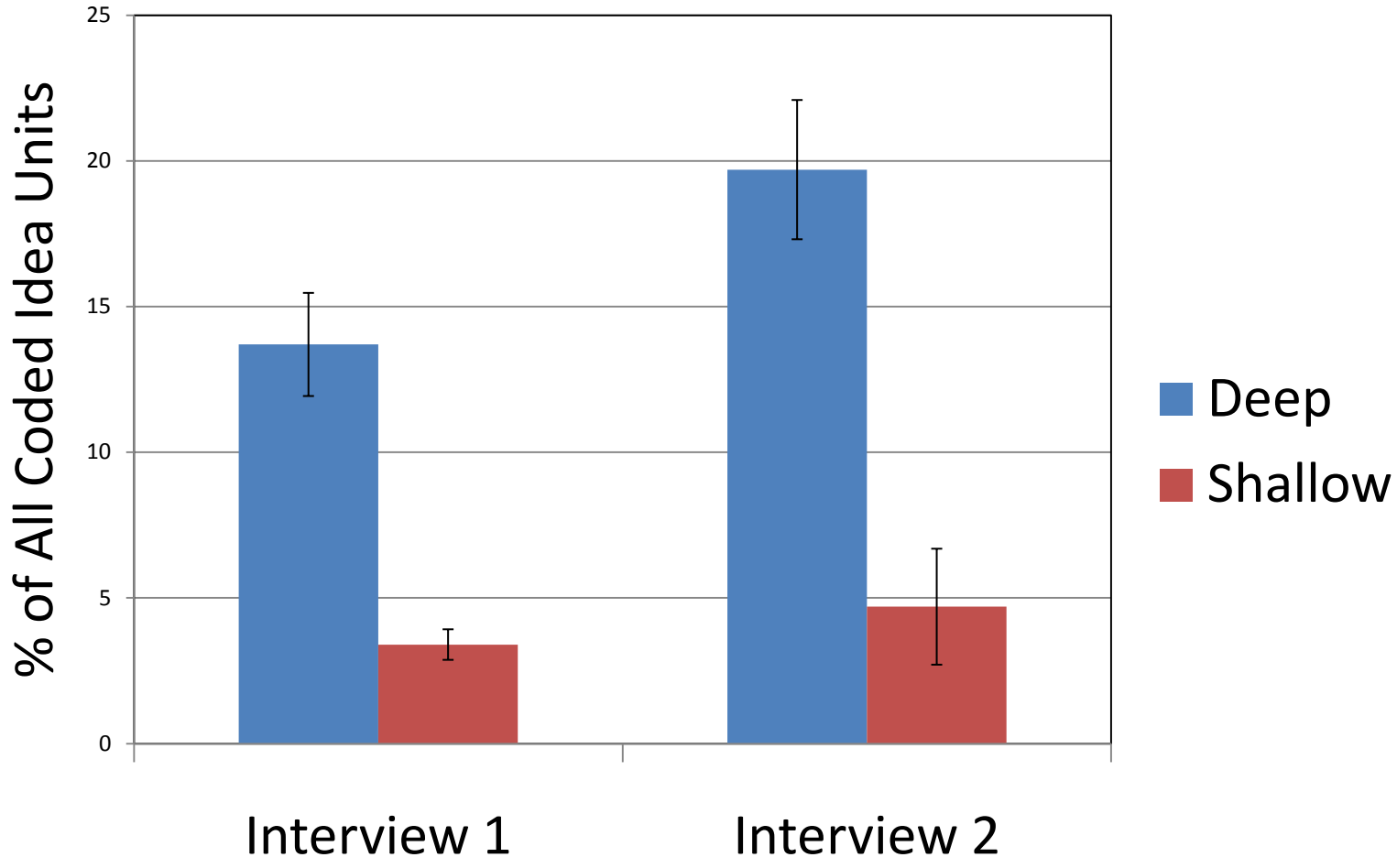
20% Interview 1 (4 raters)	Overall Kappa
Level 1 Codes	.69
Level 2 Codes	.57
Level 3 Codes	.51

20% Interview 2 (3 raters)	Overall Kappa
Level 1 Codes	.69
Level 2 Codes	.53
Level 3 Codes	.41

Statements about Science Content



Statements about Pedagogical Strategies



CCS Use: Serving Teachers with Knowledge Needs?

*Frequencies are self-reported on a separately-gathered user survey.	**Amount of Shallow Talk about Science Content in Interview 1**
*Frequency of Using Curriculum Customization in Previous Semester	r = .47 p > .24
*Frequency of Using CCS to Research Student Misconceptions	r = .89 p < .02
*Frequency of Using CCS to Customize Instruction for Small Groups of Students	r = .94 p < .01

Conclusions

- Cognitive Interview Protocol is **successful method** to collect rich data on teacher knowledge
- **Cognitive codes: rigorous, useful** way to analyze teacher knowledge
- During CCS use, **teachers increase depth** of their **talk about science content**
- CCS appears to serve as an **effective tool** for teachers with **greater knowledge needs**

CCS Researchers/Contributors

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Questions?

Sunrise at Bryce Canyon National Park: October 11, 2010