Assessing Key Cognitive Strategies for College Readiness

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Bill & Melinda Gates Foundation
Mathematics Assessment for Learning
Convening July 21, 2009
Gates Foundation Goal

80 percent of low-income, minority students will graduate from high school college-ready by 2025
Gates Priority Elements

• College-Ready work for all students
  – Common Core (academic content) and Essential Skills (behaviors and thinking processes) aligned to college-ready competencies
    o Relationship to fewer, clearer, higher standards
  – High quality assessment aligned to standards frameworks that measure important knowledge and skills in deeper ways
  – New tools and methods for effective teaching and course design aligned with common core standards, Essential Skills, and new assessment

• CRESST/EPIC areas of collaboration
  – Development of framework for Essential Skills
  – Validation of new standards in relation to college readiness
  – Alignment of new assessments to college readiness
Overview of the Educational Policy Improvement Center (EPIC)

• Nonprofit research center founded in 2002 by Dr. David Conley, CEO, and Professor, University of Oregon, to help policymakers and educators use educational policy to improve schooling

• Research focal areas:
  – College readiness definition and standards
  – Studies of entry-level college courses, CTE, placement tests
  – High school-to-college alignment diagnostic tools, strategies
  – Course document analysis studies and systems
  – Classroom-based assessment design and implementation

• Major current partners include national educational organizations, state education departments and higher education boards, school districts, foundations, and school networks
Four Key Dimensions of College Readiness
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- Key Cognitive Strategies
  - Problem solving, research, interpretation, reasoning, precision and accuracy
- Key Content Knowledge
  - Key foundational content and “big ideas” from core subjects
- Academic Behaviors (self-management)
  - Time management, study skills, goal setting, self-awareness, persistence
- Contextual Skills and Awareness (“college knowledge”)
  - Admissions requirements, affording college, colleges types and missions, college culture, relations with professors

Download at: www.epiconline.org
Importance of Key Cognitive Strategies

- Conceptual framework for the key cognitive strategies
  - Thinking processes can be learned
    - Thinking ability is a disposition, not an attribute
  - Thinking is necessary to construct and retain new knowledge
  - Young people develop expertise by moving from novice to expert via progressively more complex tasks
    - Developing thinking capabilities requires such a progression

- College faculty nationwide express near-universal agreement that most students arrive unprepared for the intellectual demands and expectations of postsecondary education
  - More specifically, students struggle with anything that is non-routine, requires them to think, or has not been told to them literally by the instructor
Framing Principles

• Effective college preparation must address all four dimensions but must be certain to develop key cognitive strategies while teaching critical, challenging content knowledge

• Next-generation classroom-embedded assessments need to assess key cognitive strategy development and:
  – be more sensitive to instruction
  – align better with college-ready competencies
  – reflect complex, valid learning
  – meet high technical standards
  – be accepted by teachers, and key constituents
College-readiness Performance Assessment System (C-PAS)
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- Gauges the development of five Key Cognitive Strategies
- Formative assessment system designed to improve teaching and learning and to make students college ready
- Built on classroom-embedded performance tasks
- Teachers score tasks using common scoring guides
- All components managed through an online system
College-readiness Performance Assessment System (C-PAS)

- Approximately 7,000 middle and high school students have participated to date
- 19 schools in the Urban Assembly, New York City
- 20 schools in the Early College High School network, CA
- Tasks cover math and English grades 6-12
- Science and social studies to be added beginning 2010
C-PAS Conceptual Design

Key Cognitive Strategies Model

1) Problem-Solving
   - A. Understanding
   - B. Hypothesizing
   - C. Strategizing

2) Research
   - A. Identifying
   - B. Collecting
   - C. Evaluating

3) Interpretation
   - A. Integrating
   - B. Analyzing
   - C. Synthesizing

4) Reasoning
   - A. Constructing
   - B. Organizing
   - C. Critiquing

5) Precision/Accuracy
   - A. Checking
   - B. Completing
   - C. Presenting
Performance Tasks

• Built on construct maps and task shells designed to elicit work that makes students use key cognitive strategies

• Multiple days to complete the task, using time in and out of class

Part 3: Interpretation

In this part of the task, you will interpret the data you have collected,

Integrating

Work Product: Graphs of data

⇒ Independent Work: After you have collected and organized your data, construct the Lorentz curves for each country and time (a total of four graphs).

Analyzing

Work Product: Written analysis based on graphs and calculations

⇒ Independent Work: Calculate Gini coefficients for each country and time.

⇒ What do you notice about the income inequality? Do you see any patterns or trends?

Part 4: Reasoning

In this part of the task, you will write your report, clearly communicating the reasoning that supports your conclusions.

Constructing

Work Product: Rough draft of report

⇒ Independent Work: Use the results of your research and analysis to write a thesis statement about the income inequality in the two countries and two times you selected.

⇒ Using your research and analysis, briefly explain and support your thesis. Clearly connect the results of your analysis to your thesis.

⇒ Be sure to explain the tools you used. Someone who has not worked with these tools should be able to understand you.

⇒ Discuss potential weaknesses with your thesis, areas where you feel support is lacking, and areas where more information would be useful.
Example Task: Share and Share Alike

Introduction

“He declared he had nothing from the Men, and Share and Share alike with them in every Bit.”

Robinson Crusoe, by Daniel Defoe

Do modern societies share and share alike? Or is it true that the rich get richer and the poor get poorer? Is the distribution of income different in different countries? Does the distribution change over time? How can the tools of mathematics be used to analyze the equality—or inequality—of distributions of income?

Final Product: A report about income inequality in two countries
Share and Share Alike

Description

Students explore income distribution using the Gini coefficient, a measure of inequality that is often used by economists and social scientists to quantify income and wealth inequality.

Students choose two countries, research data on income distribution for the countries, and represent the data graphically and by calculating the Gini coefficient.

Students use their analysis to make and support an argument about the relative changes in inequality in the two countries over a period of time.
Student Work: Lorenz Curves

In all of the graphs you can clearly see four distinguishing factors of income inequality which are: the cumulative percent of income, the cumulative percent of people, the perfect equality line, and the Lorenz curve.

Dominican Republic 1989

Cumulative Percent of Income

Cumulative Percent of People
Construct, read, and interpret graphical displays of data to describe the distribution of data
Solve problems involving ratios in the context of the situation
Use estimation to check for errors and reasonableness of solutions
Translate among multiple representations of a relationship
Make connections between geometry and algebra, describing lines in the coordinate plane
Compute and describe summary statistics
Analyze and describe similarities and differences by comparing graphical distributions within and between data sets
Describe the reliability of statistical results from a set of data
Some of the key cognitive strategies students employ in this task are:

- Hypothesize about a relatively unfamiliar topic: income inequality
- Locate numerical data presented in an Excel spreadsheet (UNU-WIDER database)
- Understand two unfamiliar statistical representations—the Lorenz curve and the Gini coefficient—and the relationship between them
- Analyze data for several cases given in multiple representations
- Identify unexpected findings and questions that arise
- Interpret results from data analysis
- Communicate in a clearly organized narrative

As you look at the task and the student work, what else can you say about the cognitive demands of this task?
# Scoring Guides

## Problem Solving

### Understanding

<table>
<thead>
<tr>
<th>Restatement of the problem</th>
<th>Exceeds</th>
<th>Meets</th>
<th>Approaches</th>
<th>Initiates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Both are present</strong></td>
<td><strong>Both are present</strong></td>
<td><strong>Both are present</strong></td>
<td>Either is present</td>
<td>Any one is present</td>
</tr>
<tr>
<td>• Restates the problem in an innovative or creative way, and includes multiple representations that demonstrate a sophisticated level of understanding of the problem.</td>
<td>• Restates the problem in own words, and includes one or more representations that demonstrate understanding of the problem.</td>
<td>• Gives reasonable preliminary explanations, and includes a sensible reason for giving them.</td>
<td>• Restates the problem in own words, and includes one or more representations that demonstrate partial understanding of the problem.</td>
<td>• Restates the problem, copying verbatim from the task.</td>
</tr>
<tr>
<td>• Gives reasonable preliminary explanations, and includes a clear justification for giving them.</td>
<td>• Gives reasonable preliminary explanations, and includes a sensible reason for giving them.</td>
<td>• Gives reasonable preliminary explanations, but includes an unclear reason for giving them.</td>
<td>• Gives reasonable preliminary explanations, but includes an illogical reason for giving them, or does not include a reason for giving them.</td>
<td>• Gives illogical or unrelated preliminary explanations, or does not give preliminary explanations.</td>
</tr>
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### Exploration of variables in the problem

<table>
<thead>
<tr>
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<th>Approaches</th>
<th>Initiates</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Clearly and correctly identifies, defines, and describes each relevant variable.</td>
<td>• Clearly and correctly identifies and briefly defines each relevant variable.</td>
<td>• Identifies all relevant variables, and correctly defines most of them.</td>
<td>• Identifies but does not correctly define most variables.</td>
</tr>
</tbody>
</table>
Scoring Criteria Example

Synthesizing

*Meanings or implications of results*

1. Interprets results effectively and thoroughly in the context of the original problem.
2. Draws appropriate conclusions based on the data analysis.
3. Identifies applications or implications of the results in the context of the task or question.
Discussion: Comments, Questions and Answers
Contact Information

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