

Early Strategies for Building Academic Literacy in Math and Science

Creating Success for All Students for Constructed Response Assessments

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U.S. Department of Education • Teacher to Teacher Initiative • Supporting Success



Outcomes for Session

- Discover methods for building literacy during problem-solving exercises.
- Gain strategies for skill development during open-ended, constructed response assessment for all students, including modifications for limited English proficient and special education.
- Assess sample responses using rubric templates.



Relevant Research

- “Writing boosts learning science and math and social studies.”

Peggy Harris, “Writing boosts learning science and math and social studies,” *The Council Chronicle* 16, no. 1, September 2006,

- In case studies of 90-90-90 schools:
 - Increased writing improved standardized test scores in all subjects including science, social studies and math
 - Constructed response helps to close the achievement gap.
 - No special program or curricula required.

Doug Reeves, “90-90-90 Schools: A Case Study,” *Accountability in Action*, 2000.



Evidence of Success

Writing as an instructional strategy

- Pretests vs. post-tests for conversion strategy showed increased retention on future tests using similar strategies all year long. (e.g., Moles, stoichiometry and solubility)
- Metacognitive writing improved vocabulary use and scores on postassessment. Increases averaged 3-6% compared to control.
- Increased confidence on state assessments.



Evidence of Success

- Explaining the rationale for finding correct answers reduces making the same mistakes and increases retention.
- Provides excellent diagnostic information about needs (vocabulary, process or communication).
- Prepares students for state standards assessments which are increasingly adopting open-ended constructed response.



Evidence of Success

LEP and special ed students

- Using graphic organizers helps to develop ideas
- Working in collaborative groups improves verbal processing
- Allows multiple learning pathways to develop

Z. Barley, P.A. Lauer, S.A. Arens, Cardelle-Elawar, "Helping at Risk Students Meet Standards," 2002.



Basic Skills for Writing Effectively

- Writing standards say students must:
 - Know the purpose of the writing
 - Organize ideas
 - Choose words and style to match intention
 - Determine structure, format, organization and text features
- NM Science and Math Standards say students must:
 - Convey results of investigations using data displays, mathematical expressions and clear, logical and concise communication.
 - Use mathematics to express and establish scientific relationships (e.g., scientific notation, vectors, dimensional analysis).



Good Questions

- Are standards-based
- Require work that represents a persistent critical issue
- Allow students to express what they are doing and why



Implementation Activity #1

Giving Oral Directions

- Pick a partner
- Materials: butcher paper, envelope, marker
- Try to describe how to draw the shape pictured in the envelope without using any of the words under the shape



Implementation Activity #2

Giving instructions:

- Give a detailed description of solving a mathematical problem.
- Describe the step-by-step process for how to solve a conversion problem.
- Exchange with another group. Second group follows instructions EXACTLY!



Looking at Student Work

- Did the student understand the problem?
- Is the work organized?
- Did the student get the right answer?
 - What techniques are used?
 - Guessing?
 - Math models?
 - Multiple paths?
- Was the student able to communicate results?
- Could student verify results?



Implementation Activity #2

- If 3 styps equal 4 selps, 9 schmecks equal 7 selps and 10 goops equal 48 schmecks. Please convert 14 styps to goops.

14 styps	4 selps	9 schmecks	10 goops
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	3 styps	7 selps	48 schmecks

- If 1 year equals 365 days, 1 day equals 24 hours, 1 hour equals 60 minutes. Please convert 1.5 years to minutes.

1.0 year	365 days	24 hours	60 minutes
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	1 year	1 day	1 hour



Discussion of Activities

- How do we encourage writing among our different populations?
- How do we get students to elaborate?
- How do we assess student learning?
 - How do we then use what we collected?
- What are your ideas for developing skills in constructed response



Implementation Activity #3

Constructed responses

- Science: A performance assessment
Density stacking
- Math
Frog and cricket hopping
- Chemistry
Theoretical yield



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