DEVELOPING A CALIBRATED PROGRESS VARIABLE FOR THE PARTICLE NATURE OF MATTER

Joi Merritt, & Joe Krajcik, University of Michigan

Research Question

• How can we construct and evaluate assessment items to show students’ development of the particle model of matter?

Progress Variable

• Mediate between big ideas and specific concepts and skills being learned
• Serve as a means for tracking student learning during instruction
  – Instruction contributes to students’ progress
  – Necessitates alignment of assessment with one or more construct maps
  (Wilson, 2005)

Particle Model

• Big idea of science® (Smith et al., 2006)
• Traditional curriculum materials introduce the particle model as fact
• Consequence: Students have difficulty using the model to explain phenomena

The IQWST Approach

• Students carefully develop ideas over time

Unit Learning Goals

- Learning Set 1: Particle Model
- Learning Set 2: Properties
- Learning Set 3: Phase changes

Smell Unit Overview

• 8-week, project-based unit for 6th grade students
• Three Learning Sets, 15 Lessons

Item Development

Large Urban K-8 School
• One teacher
• Three 7th grade class
• 92 students

Data Collection
• Two exams (Form A & B)
• 12 multiple-choice items
• 2 written response items
• Student interviews

Data Analysis
• ConstructMap
• Rasch Modeling
• Analysis of interviews

Findings

Reliability

• Mean for all respondents: 1.24 logit ± 0.28

Validity

• Evidence based on instrument content
• Evidence based on response processes
  – Revealed issues with items on explaining how thermometers work
  – Difficulty depicting phase changes
• Evidence based on internal structure
  – Evidence supporting the Construct map
    – Spearman rank-order correlation: 0.62
  – Item steps ordered
  – Evidence supporting the Item Design
  – Item Analysis
  – Differential Item Functioning
  – Evidence based on relations to other variables
  – Total raw scores only highly correlated with proficiency estimates

Conclusion

• Calibration of a progress variable
  – Is complex and involves many steps
• Progress variables
  – Track student learning during instruction
  – Informs curriculum AND item development
  – Can aid in the development and evaluation of a learning progression

Next Steps

• Analysis of results with a larger sample size
  – 1000 6th grade students from 6 schools in 4 different states
• Further refinement of construct map
• Conduct interrater reliability of written response items