Tracking Growth in Students’ Understanding of the Particulate Nature of Matter

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Background

Chemistry is commonly represented at three levels¹

MACROSCOPICAL LEVEL
SYMBOLIC LEVEL
PARTICULATE LEVEL

Students struggle with the particulate level the most as shown in high school and college settings 2, 3, 4

• Many misconceptions for both ionic & covalent reactions
• Particulate level is the most cognitively demanding

Tracking student particulate representations over the course of the semester can give us a sense of growth in understanding

Research Questions

How does the students’ understanding of the particulate nature of matter change over the course of a general chemistry course? What aspects do students have difficulty with throughout the course, and which aspects do students master?

Methodology

Context

• Study took place in a general chemistry class in Fall 2014
• Students demonstrated their knowledge of the particulate nature of matter by drawing representations throughout the course
• 53 students took part in the study
• One semester of HS chemistry required

Assessment

Compound and Equations Analyzed
N₂O₅(aq) → N₂O₄(g)
CaCl₂(s) + CO₂(g) → 2HCl(aq) + 2CO₂(g)
2NaNO₃(s) + CaCl₂ → 2AgCl(s) + 2CO₂(g)
2CH₃COOH + 2OH₂(g) → CH₂CO₂(g) + H₂O + 3CaCl₂(s)

Assessment Dates
9/6, 10/25
9/6, 10/9
10/4, 10/25
10/9, 10/25
12/6

Coding and Analysis

• Coded specific errors as well as aspects they are understanding

Future Work

• Compare Fall 2013 data with Fall 2014 data for trends
• Determine if other questions are having an influence in how the students answered their particulate representation questions
• Determine if order of instruction has impact on understanding
• Include student reflections in analysis

Discussion

Growth in understanding was noted in:

• Molecular geometry
• Understanding that ionic compounds have charges and that aqueous ions are separated and solid compounds form a lattice
• A statistically significant number of students are understanding that molecular compounds do not ionize.

Continued struggle with:

• Oxidation number
• Using covalent bond model for ionic compounds
• Nature of particles in aqueous solution

Student understanding stayed constant in:

• Atomic size for covalent compounds
• Balancing the particles

References


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