Computerized Analysis of Student Writing and Student Ideas about Scientific Concepts

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Introduction

• Students in introductory biology course struggle with chemistry concepts despite a chemistry course prerequisite.
• Constructed-response assessments reveal student thinking and conceptual barriers. (Birenbaum & Tatsuoka, 1987)
• Students have complex, heterogeneous ideas which may not be captured by multiple choice questions. (Nehm & Schonfeld, 2008)
• We use a linguistic-feature based approach to automated analysis (Deane, 2006)

Assessment item and student responses

Q: Consider two small organic molecules in the cytoplasm of a cell, one with a hydroxyl group (-OH) and the other with an amino group (-NH2). Which of these small molecules (neither or both) is most likely to have an impact on the cytoplasmic pH?

A. Amino (35%)
B. Hydroxyl (45%)
C. Both (13%)
D. Neither (7%)

Please explain your answer.

• Homework in introductory biology course.
• 374 responses collected via online course management system.
• Analyzed explanations for correct multiple choice selections.

Term extraction

• Lexical analysis can process large numbers of responses easily
• Software identifies key terms and groups similar terms into categories (i.e. concepts)

Expert scoring

• Two expert scorers rated using 3-level rubric; agreement on 113 out of 129 (interrater reliability=0.92; intraclass correlation)

Statistical modeling

• Statistical functions can predict expert scoring at 77% accuracy
• Computer-expert interrater reliability = 0.84 (intraclass correlation)

Category building

• Lexical analysis can reveal complex patterns in students’ concepts

Lexical analysis software showing the terms extracted (lower left panel), categories (upper left panel), student responses (right panel). Each response is placed into one or more categories (rightmost column).

Automated Analysis of Constructed Response (AACR) Research Group

Who we are:
• Michigan State University
• The Ohio State University
• University of Colorado – Boulder
• University of Washington
• Grand Valley State University

What we’re doing:
• Metabolism Diagnostic Question Cluster (DQC)
• Genetics Concept Assessment (GCA)
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