Adaptive Learning Technology to Teach Background Material in Intro STEM

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In your experience...

- What are common challenging background topics in your field?
- How would you confirm/identify them in a course?
Finding Topics
Finding Topics

- personal experiences
  - professor input
  - previous experiences in course and related courses

- course data
  - existing exams
  - entry/exit assessments
### Finding Topics: Neuroscience

<table>
<thead>
<tr>
<th>Question</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>Total</th>
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<tbody>
<tr>
<td>S12 – Q17</td>
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<tr>
<td></td>
<td>67%</td>
<td>88%</td>
<td>86%</td>
<td>80%</td>
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<tr>
<td>S15 – Q6</td>
<td>a</td>
<td>b</td>
<td>c</td>
<td>d</td>
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<td></td>
<td>95%</td>
<td>82%</td>
<td>89%</td>
<td>60%</td>
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Finding Topics: Neuroscience

- diffusion
- membrane permeability
- electrical properties
Finding Topics: Chemistry

**Entry Assessment**
- using Avogadro’s number (24% correct)
- limiting reactant (6%)
- electrostatic energy scaling with charge and distance (<5%)
- multiplication and division of measurements (<5%)
- using ideal equation of state (10%)

**Exams**
- unit conversion (20% correct)
- molecular formula from elemental analysis (32%)
- ideal gas model and law (60%)
- lattice energy (50%)
Finding Topics: Chemistry

- unit conversion / dimensional analysis
  - using Avogadro’s number
  - limiting reactant
  - multiplication and division of measurements

- ratios / direct and inverse relationships
  - ideal gas law / ideal equation of state
  - electrostatic energy scaling
  - lattice energy
Understanding Challenges
Continuing the discussion...

- Thinking about the background topics you identified earlier, select one topic and think about what could be the underlying difficulties/missing pieces?
- How would you distinguish the underlying problems?
Understanding Challenges

▪ how vs. why
  – Can a student set up and solve the problem? Does a student remember the correct answer?
  – Does a student understand why they used a given setup to solve the problem? Can a student explain why they gave a certain answer?

▪ context: original vs. new
  – Can a student recognize and solve the problem in the context they originally learned it?
  – Does a student recognize the previously learned material when it appears in a new setting?
• Q3: During the process of diffusion, particles will generally move from
  – high to low concentration. (98%)
  – low to high concentration.

• Q4: The reason for my answer is because
  – crowded particles want to move to an area with more room.
  – the random motion of particles suspended in a fluid results in their uniform distribution. (31%)
  – the particles tend to keep moving until they are uniformly distributed and then they stop.
  – there is a greater chance of the particles repelling each other.
Understanding Challenges: *Context* Chemistry

- dimensional analysis / unit conversion
  - unit conversion (g ↔ mol) / using Avogadro’s number: 20%
  - *simplify ratio / quotient rule*: >90%

- ratios / direct and inverse relationships
  - ideal gas law / lattice energy: 50-60%
  - *direct and inverse relationships*: ?
Design & Deployment
Design & Deployment

- technology concerns
  - branching pathways
  - in-house design and control
  - ease of use
Design & Deployment: Storyboard

quiz-based

question-based
Design & Deployment: Example
Design & Deployment
Design & Deployment: Your Turn

- How would you design a module for the topic you identified earlier?
- What would your storyboard look like?
Lessons Learned (so far)

- plan everything (as much as possible) before building
- consider what type of data you want at the end
- let someone try to break it
- (if applicable) add in questions about student background, confidence, perceived help from module
Questions?