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

Question						Total
S12 – Q17	a	b	c			
	67%	88%	86%			80%
S15 – Q6	a	b	c	d	e	
	95%	82%	89%	60%	74%	81%

Finding Topics: Neuroscience

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: *How vs. Why* Neuroscience

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: ?*

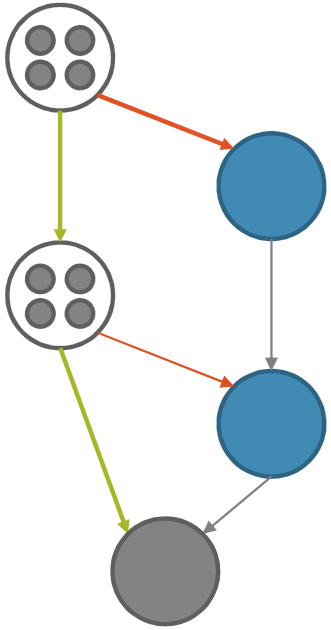
Design & Deployment

Design & Deployment

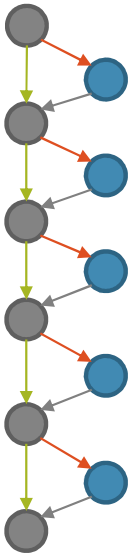
- technology concerns
  - branching pathways
  - in-house design and control
  - ease of use

Design & Deployment: Storyboard

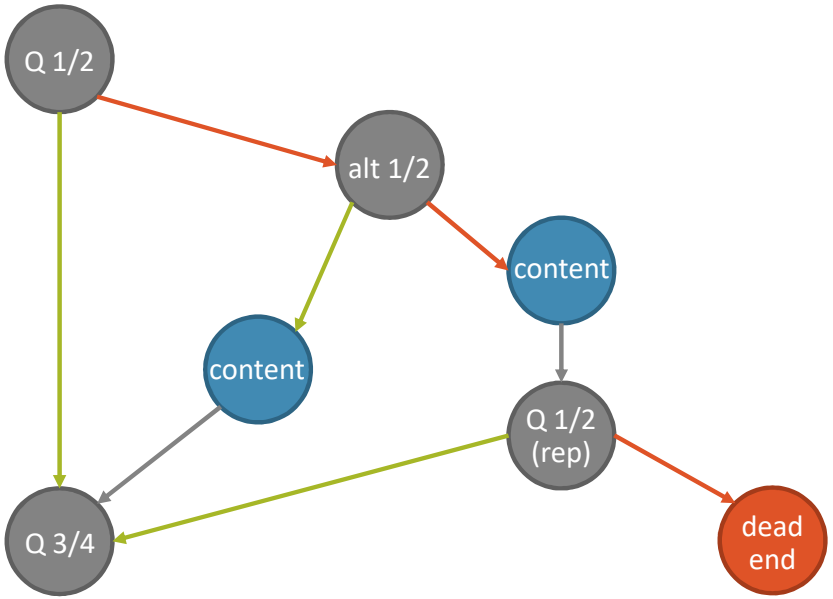
quiz-based



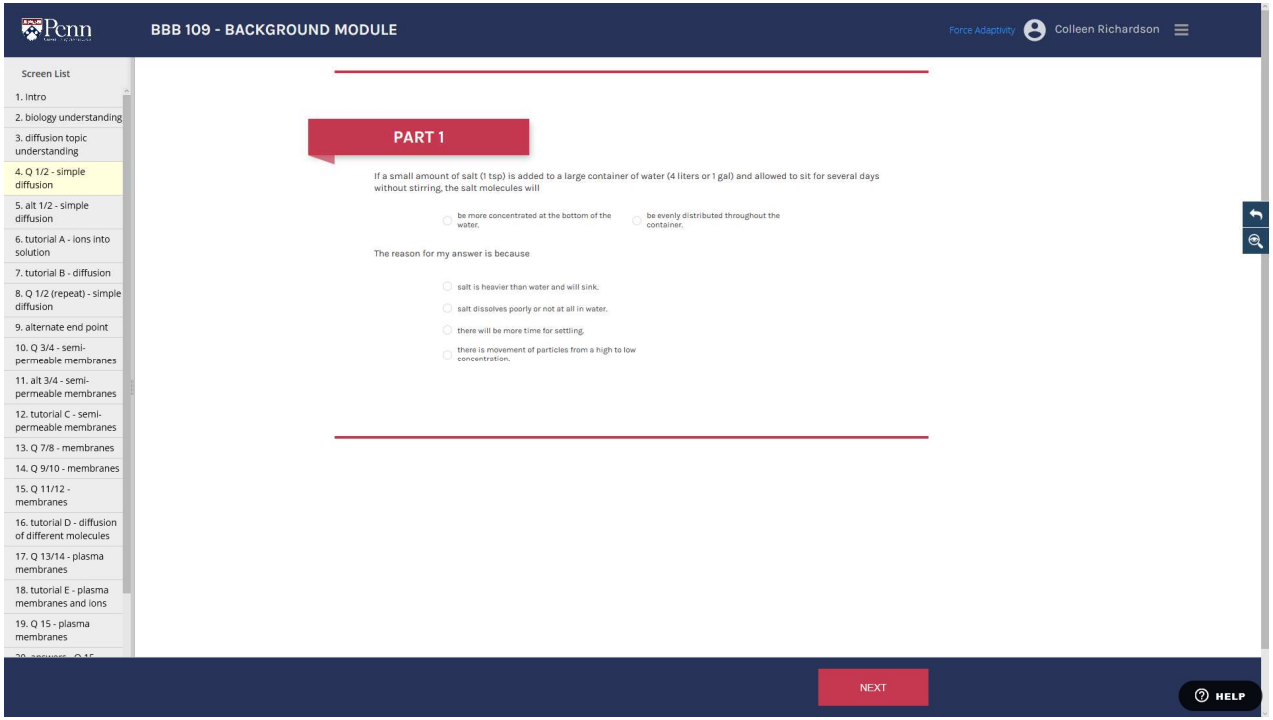
question-based



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?