A Learning Model to Inform Teaching Practice

Outline

- What does cognitive science tell us about learning from audiovisual information?
- What are the ‘best-practice’, instructional design principles that stem from this research?
- Compelling evidence for this model from chemical education research
- How can a learning design be based on these principles?

Cognitive Science Research

There is a wealth of convincing evidence from research in psychology, cognitive science, and education to support a model for how we process new information.
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Instructional design considerations

- **activate the attention networks** by
  - drawing on prior knowledge
  - doing something unusual, creative, or even generating cognitive conflict
  - explaining new terms, visual symbols and assumptions/approximations

- **reduce cognitive load** by
  - segmenting information flow into short sequences, with student control over direction and pace
  - minimising audiovisual clutter
  - using visual + verbal information (rather than just text); visual and verbal/text should be synchronous, close, *not* captioned
  - **chunking** information

- **facilitate linking of new ideas to existing ideas** by
  - practicing with exercises and problems
  - transferring to new situations
  - peer discussion

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**A typical problem in chemistry**

Take the following chemistry problem as an example:

“What volume of 1.0M hydrochloric acid solution will react exactly with 10.0g chalk?”

How many thought steps are there?

1. recall chalk is calcium carbonate
2. recall formula CaCO$_3$
3. calculate molar mass to be 100 g mol$^{-1}$
4. deduce 10 g is 1/10 mol
5. recall reaction products and formulas
6. balance equation
7. deduce mole relationship
8. deduce 1/5 mole HCl required
9. deduce 200 mL 1.0 mol L$^{-1}$ HCl solution required
Question complexity and performance

How do you think the fraction of students who get the question correct depends on the complexity of the question?

Johnstone, AH & El-Banna, H. 1986 Education in Chemistry May pp 80 - 84

Question complexity and performance

Why is there a ‘catastrophic’ decrease in performance at around 5 – 7 steps?

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VisChem learning design

- engaging phenomenon leading to cognitive conflict (if possible)
- peer discussion to raise issues, storyboard ideas
- look for key features in visualisation to make sense of observations
- amend storyboard, and apply to new situations

Go to learningdesigns.uow.edu.au/exemplars/info/LD9