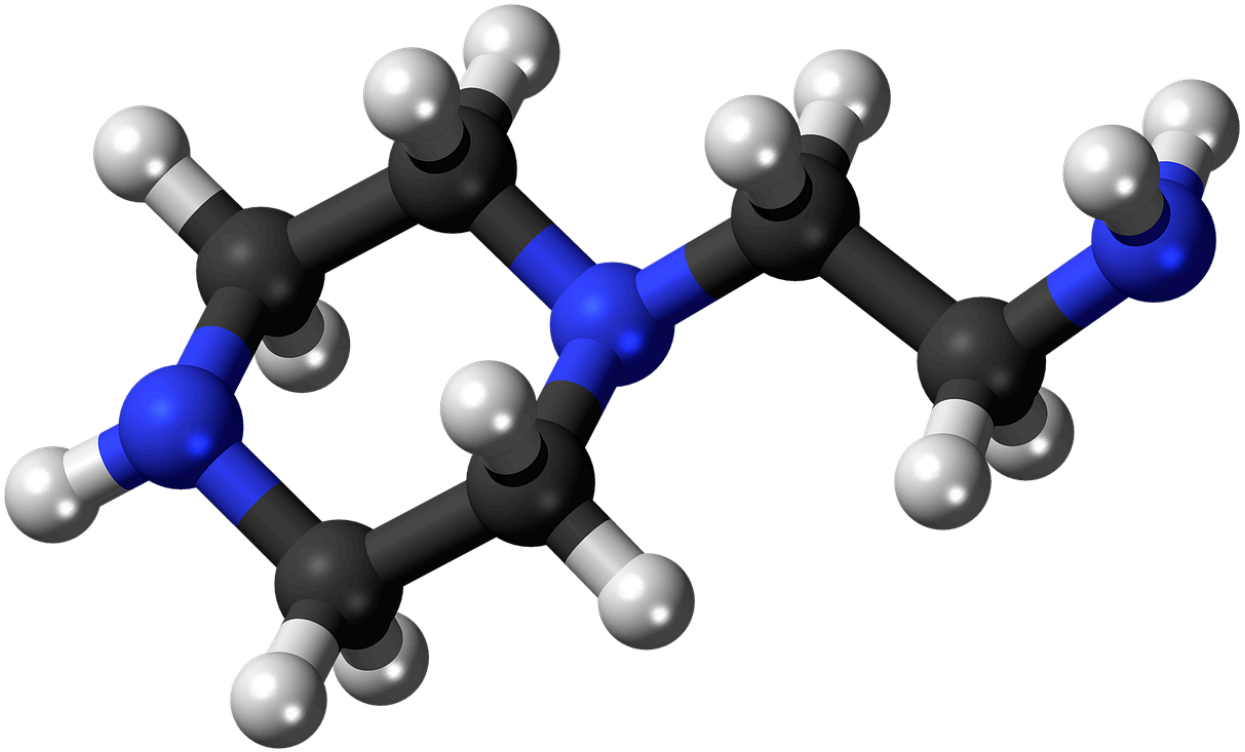
Novices and Formative Assessment

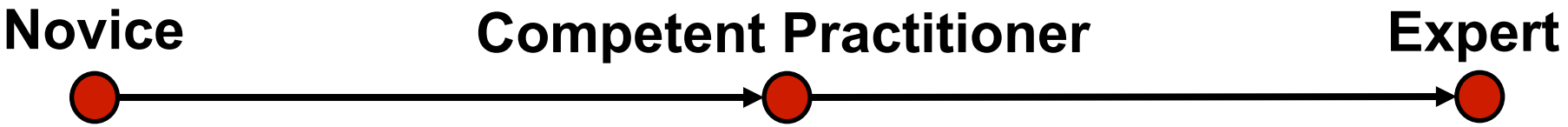
Cognitive Development and Mental Models

- What is a mental model?



How to Characterise Skill?

- Differences in skill – mental model 'big picture'
- Dreyfus model of skill acquisition simplified:



Doesn't know what they don't know – no *mental model* of domain

Reason by analogy and guesswork

Borrow from other mental models that seem similar

Good mental model for everyday purposes, e.g. driver and car

Model perhaps not completely accurate

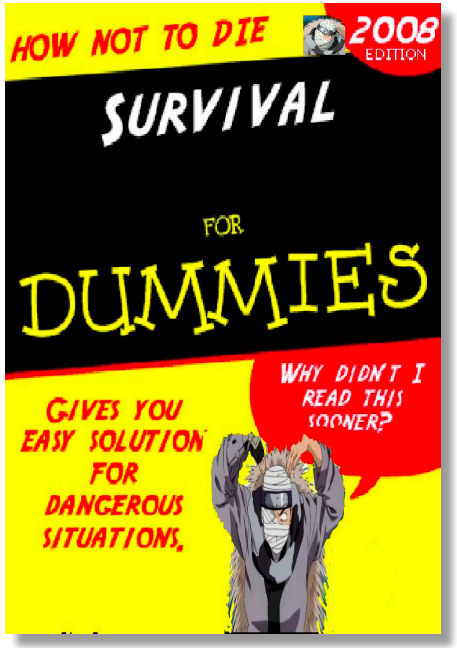
Can do normal tasks with normal effort under normal circumstances

Can handle out of the ordinary situations

Diagnose problem causes

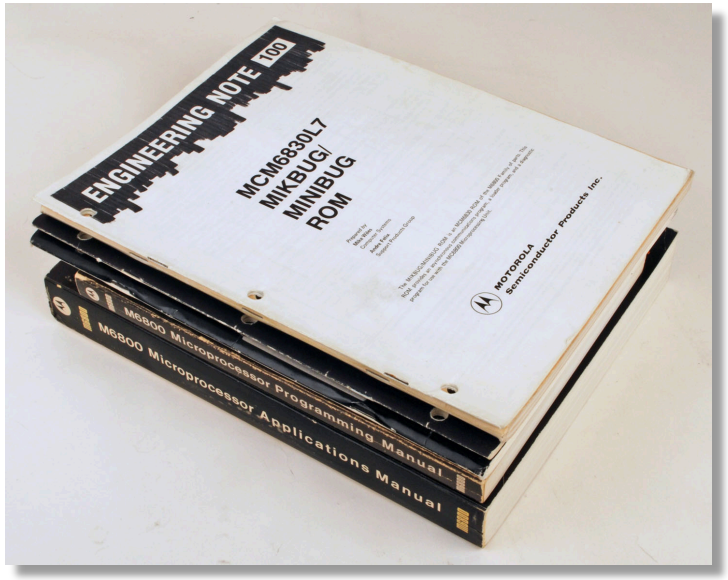
Tutorial vs Manual

- Novices, competent practitioners, experts need to be taught *differently*



Tutorial

vs



Reference Manual

Tutorial vs Manual

Tutorial

Numbered bullet points

Very specific for specific tasks

Example-based

Step by step – process

Motivational

Instructive

Fun

Acquiring skill

Manual

Organised by specific parts

Very comprehensive

Descriptive

Boring

Dense

Problem solving focus

Assume Carpentry learners are Novices

5-15% use GPU clusters to analyze petabytes in the cloud

85-95% send each other spreadsheets by email

- Easy to overload novices with too many facts
  - Unix shell lesson – 15 commands in 3 hours!
- Help them develop a *working mental model*

Building Useful Mental Models

"It ain't what you don't know that gets you into trouble, it's what you know for sure that just ain't so" – Mark Twain

- Clearing up learners misconceptions
  - **Simple factual errors** – easy to correct, but not enough
  - **Broken models** – correct by reasoning, address contradictions ***Our focus!***
  - **Fundamental beliefs** – e.g. "world is only a few thousand years old", can't really address these

What happens next?

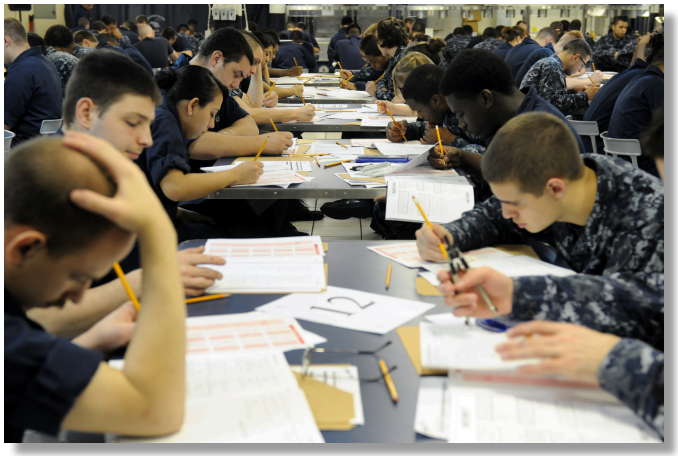
- Example of correcting a broken mental model

- Place block of ice in a bathtub, fill tub to brim with water
- When ice melts, does the water level:
  1. Go up (overflowing the tub)
  2. Go down
  3. Stay the same?

Assessing Mental Models

- Need to expose the broken mental models

Summative Assessment



Did desired learning take place?
Can learner move on?
Pass or fail

Formative Assessment

Guide learning by informing instructor and learner what to focus on
No pass or fail

Our focus!

Multiple Choice Questions

- Formative assessment needs to be quick to administer and evaluate – e.g. MCQs

Q: what is 27 + 15?

a) 42
b) 32 *Throwing away carry completely*
c) 312 *Carried '1' is actually a ten to be added*
d) 33 *Carrying '1' by adding to wrong column*

Applying MCQs

1. Teach some stuff
2. Present MCQ probing for misconceptions
3. Students vote on MCQ answers
   - Mostly all right answers, move on
   - Mostly all same wrong answer, address misconception
   - Mix of right and wrong, rewind to previous point, or get them to discuss

- Recommend every 15 mins or so – break up session
- Can use preemptively!

Exercise

Create *multiple choice question related to topic you intend to teach*

Explain *diagnostic power of each distractor, i.e. what misconception is each distractor meant to identify? A sentence for each is fine*

Pair *up with your neighbor and discuss your MCQs, providing feedback*

Place answers in Etherpad:

- *http://bit.ly/ITCam2016*

Notes on MCQs

- A good MCQ tests for conceptual misunderstanding, not facts
- For distractors, think about problems from previous training events
- MCQs are useful even if not used!

Exercise

Describe *another kind of formative assessment you have seen or used*

Explain *how it helps both instructor and learner figure out where they are and what they need to do next*

Place answers in Etherpad:

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