

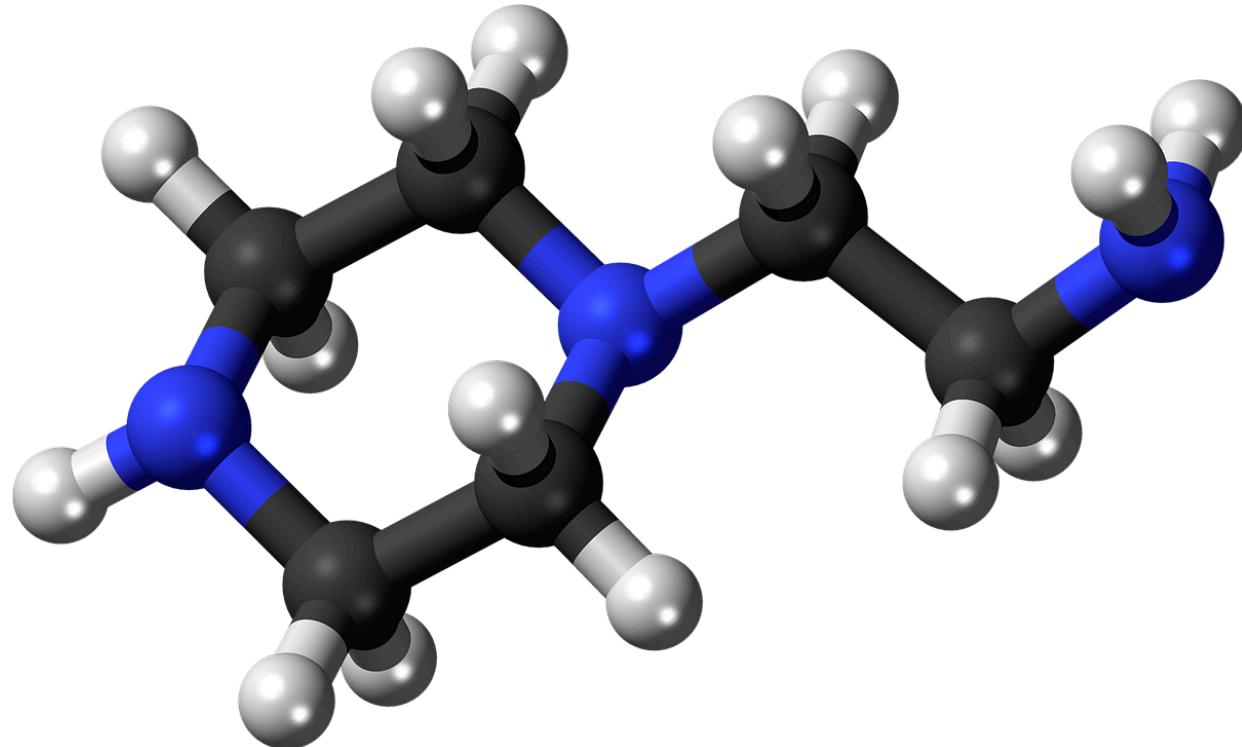


Novices and Formative Assessment

Cognitive Development and Mental Models

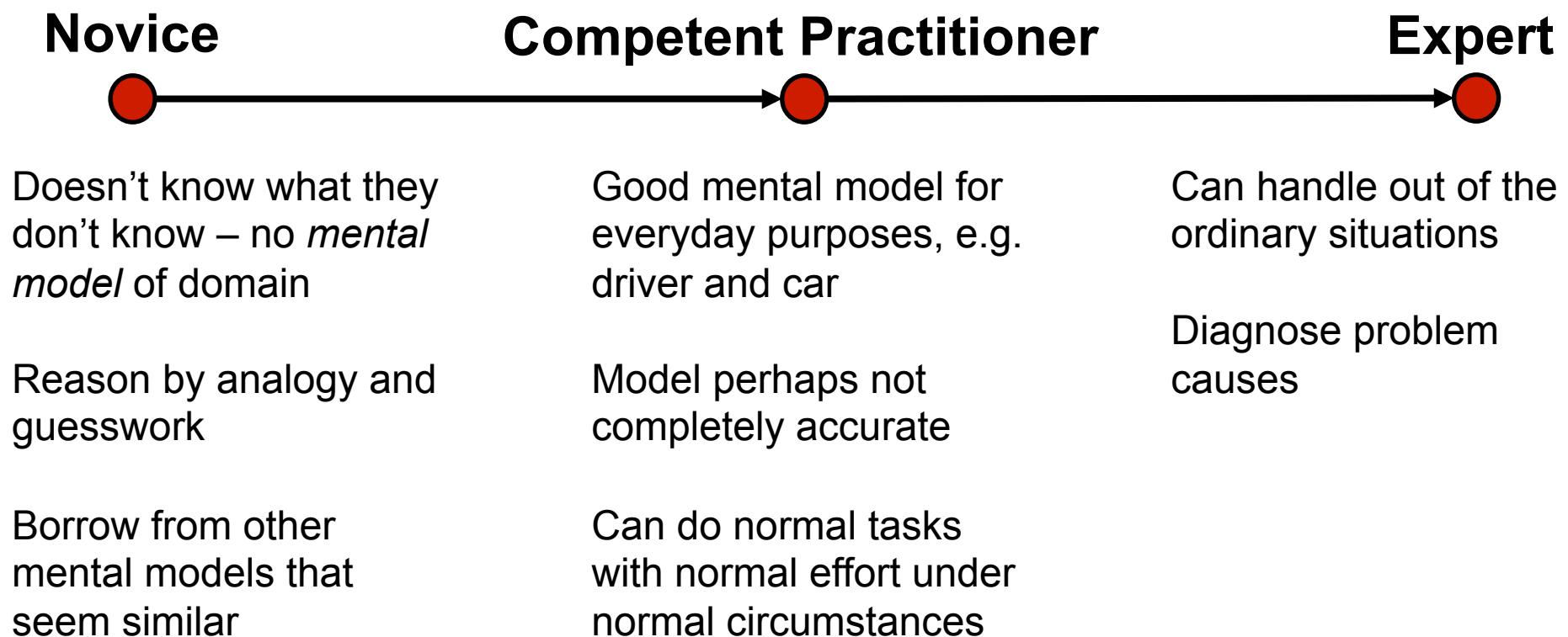


- What is a mental model?



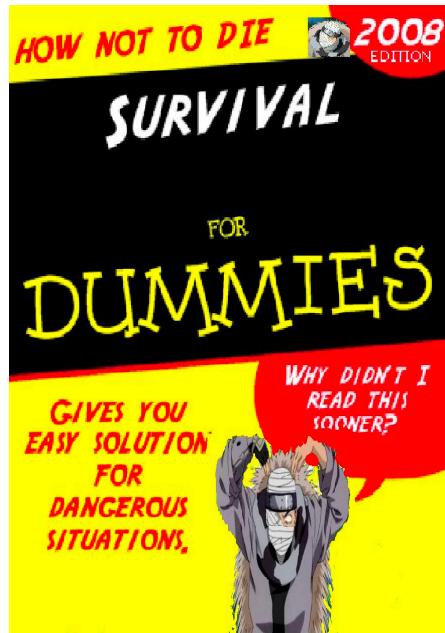
How to Characterise Skill?

- Differences in skill = different mental model
- Dreyfus model of skill acquisition simplified:

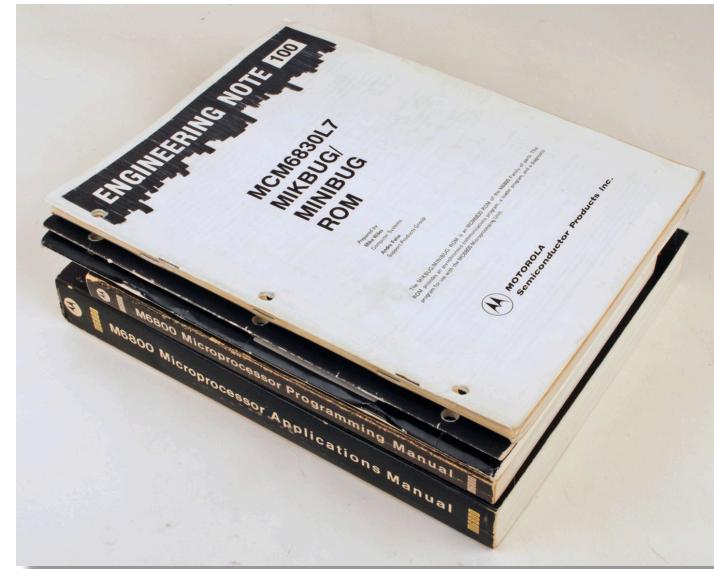


Tutorial vs Manual

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



VS



Tutorial

Reference Manual



Tutorial vs Manual

Tutorial

Narrative
Practical
End goals
Trivial cases
Works progressively
Doesn't assume prior knowledge
Interactive
Explains not just describes

Manual

Generic
Comprehensive
Detailed
Easy to find information
Technical language
Cross-references
Non-linear
Machine generated
Dull, boring!

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



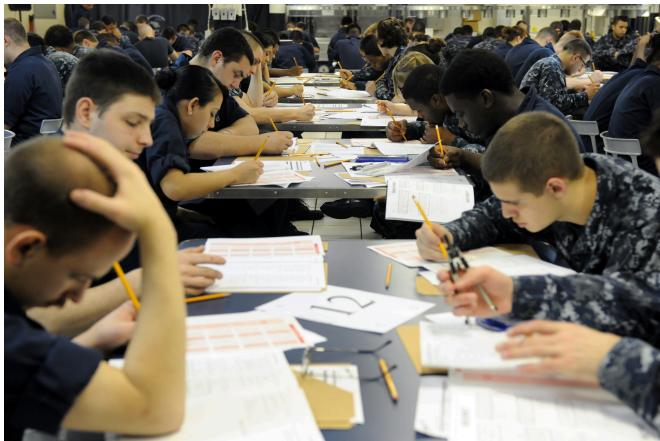
What happens next?

- 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

*Image Nathan Russell
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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 Google Doc:

- <http://bit.ly/ITOxfordMar>



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!