Live Coding Workshops DS & AI Educators Training

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Bio

- Iñigo Aldazabal Mensa
- PhD in Computational Physics, currently High Performance Computing Specialist
- Materials Physics Center (Spanish National Research Council - CSIC), San Sebastian, Spain
- The Carpentries certified Instructor since 2016
- Hosting, instructing and helping at least couple of Software Carpentries workshops a year since
- The Carpentries certified Instructor Trainer since 2022 (my first in person training here!)
- Code Refinery local team coordinator

The Carpentries aims to teach computational competence to learners though an applied approach:

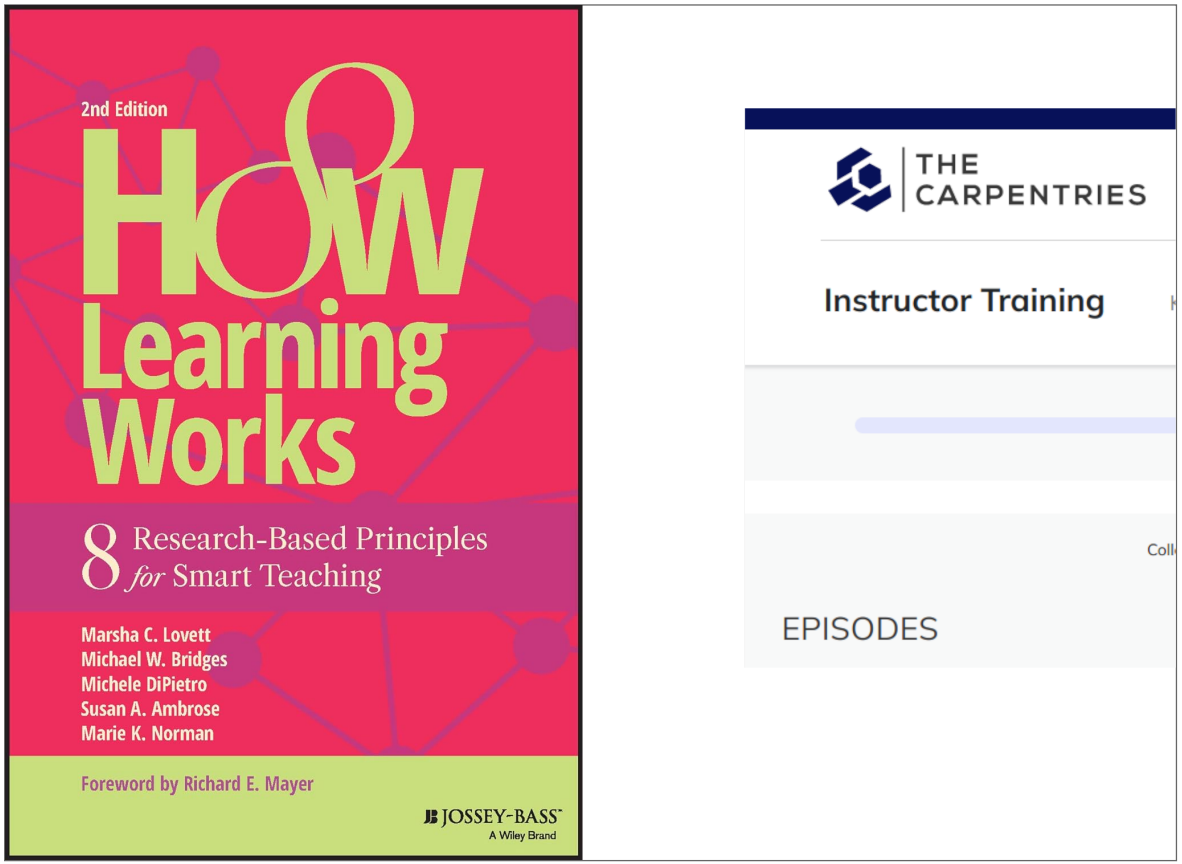
- Learners are shown how to solve specific problems with specific tools
- Hands-on practice
- Lay the fundation for future learning

A Carpentries workshop is an interactive event

- Both for learners and instructors (and helpers!)
- Give and receive feedback continuously
- Incorporate assessments within the lessons materials
- Feedback with sticky notes

Summary

- Three relevant concepts to keep in mind when teaching / preparing lessons:
    - Expertise Levels
    - Mental Models
    - Cognitive Load
- Live Coding:
    - What is and why Live Coding
    - Top ten Tips for Live Coding
    - Hands-on practice


2nd Edition
How Learning Works
8 Research-Based Principles for Smart Teaching
Marsha C. Lovett
Michael W. Bridges
Michele DiPietro
Susan A. Ambrose
Marie K. Norman
Foreword by Richard E. Mayer
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Expertise Levels, Mental Models, and Cognitive Load

Question:

- How do people learn?
- How are we (as Instructors) different from our learners and how does this impact our teaching?
- What is cognitive load and how does it affect learning?

Objectives

- Compare and contrast the three stages of skill acquisition; explain what differentiates an expert from a competent practitioner.
- Understand the limitations of knowledge in the absence of a functional mental model.
- Identify strategies for becoming aware of your expert awareness gap.
- Being aware of the quantitative limit of human memory and its relation with a learning task.

How do people learn: expertise levels

Research indicates that through practice and formal instruction, learners acquire skills and advance through distinct stages. In simplified form, three stages of this model are:

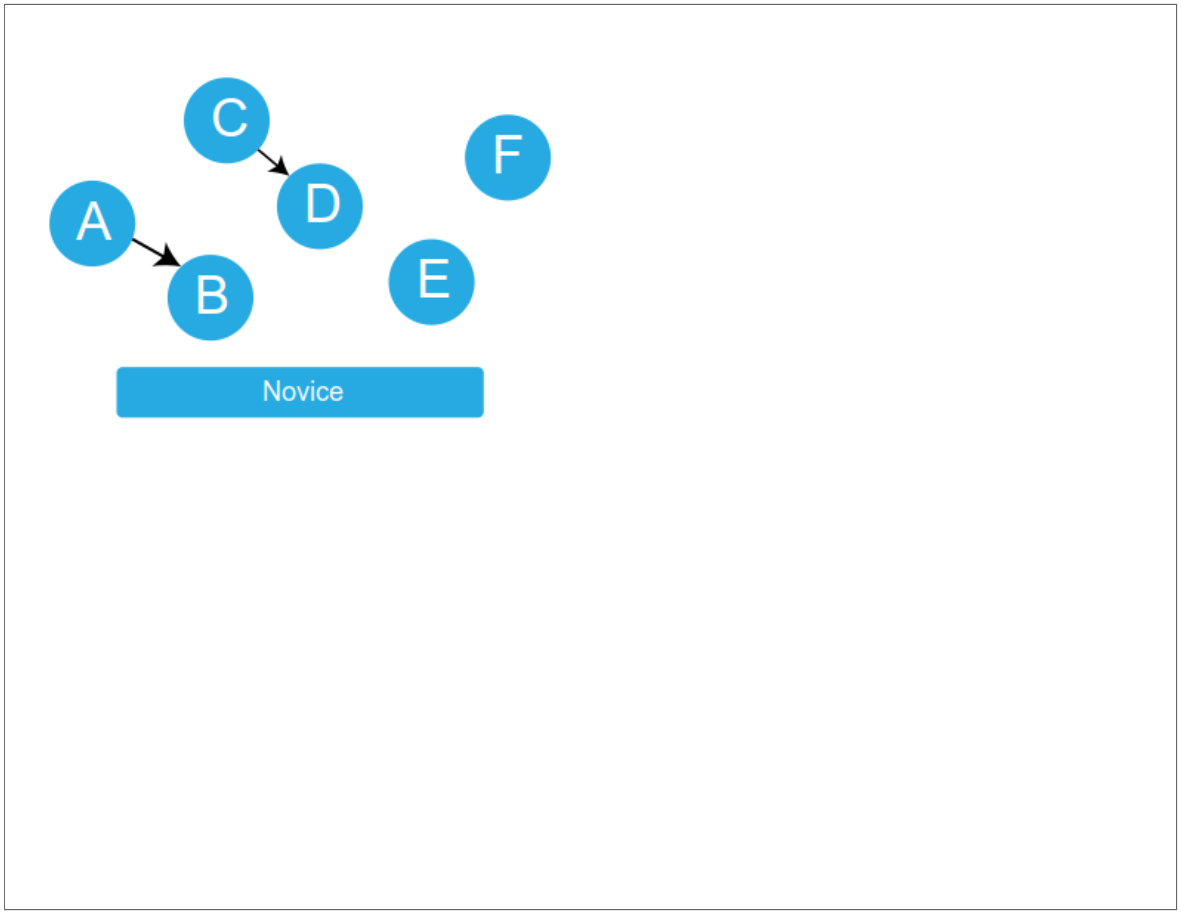
- *Novice*: someone who does not know what they do not know
- *Competent practitioner*: someone who has enough understanding for everyday purposes
- *Expert*: someone who can easily handle situations that are out of the ordinary

Expertise Levels and Mental Models

Understanding is never a mirror of reality, even for an expert; rather, it is an internal representation based on our experience with a subject. This internal representation is often described as a mental model. A mental model allows us to extrapolate, or make predictions beyond and between the narrow limits of experience and memory, filling in gaps to the point that things “make sense.”

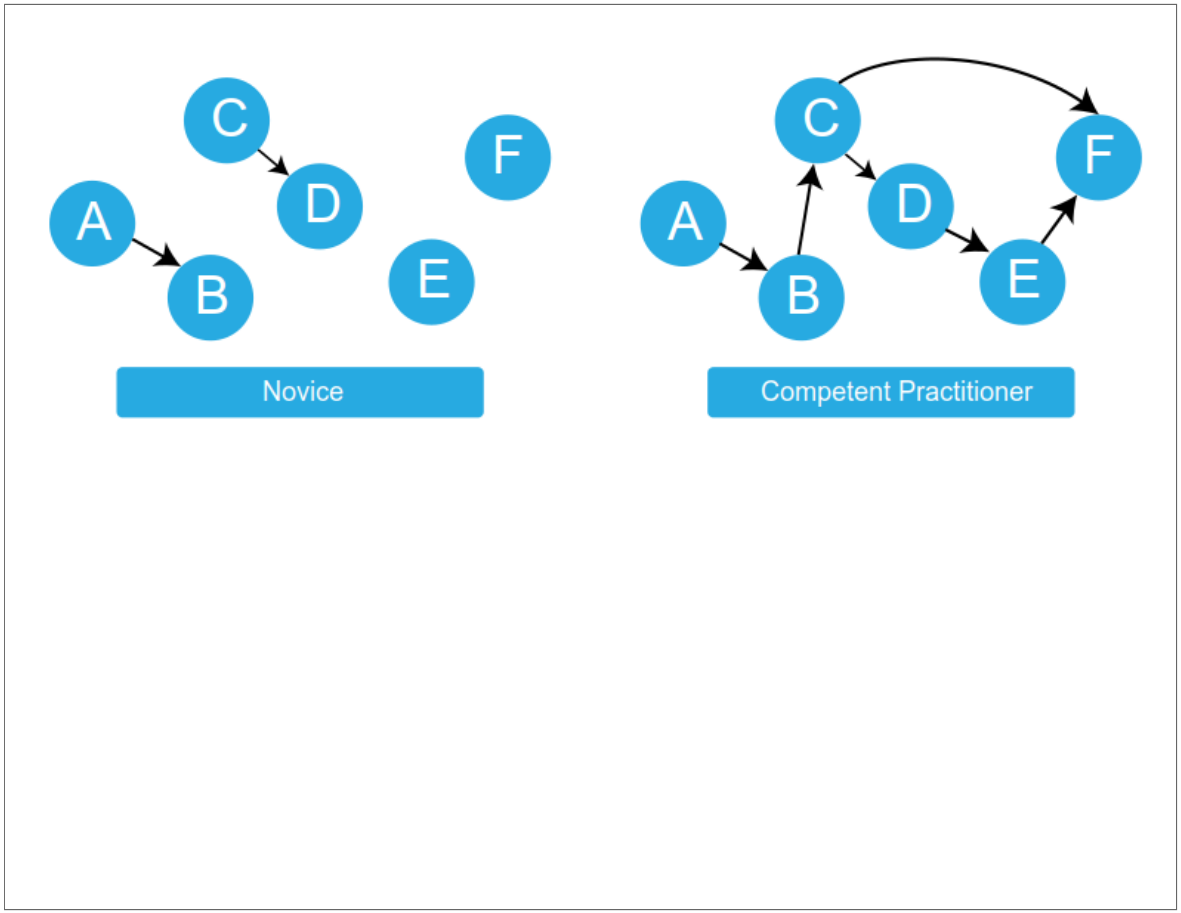
As we learn, our mental model evolves to become more complex and, most importantly, more useful. A useful model makes reasonable predictions and fits well within the range of things we are likely to encounter. While there will always be inaccuracies – or “misconceptions” – these do not interfere with day-to-day functioning. A useful model does not seize up or break down entirely as new concepts are added.

Mental models



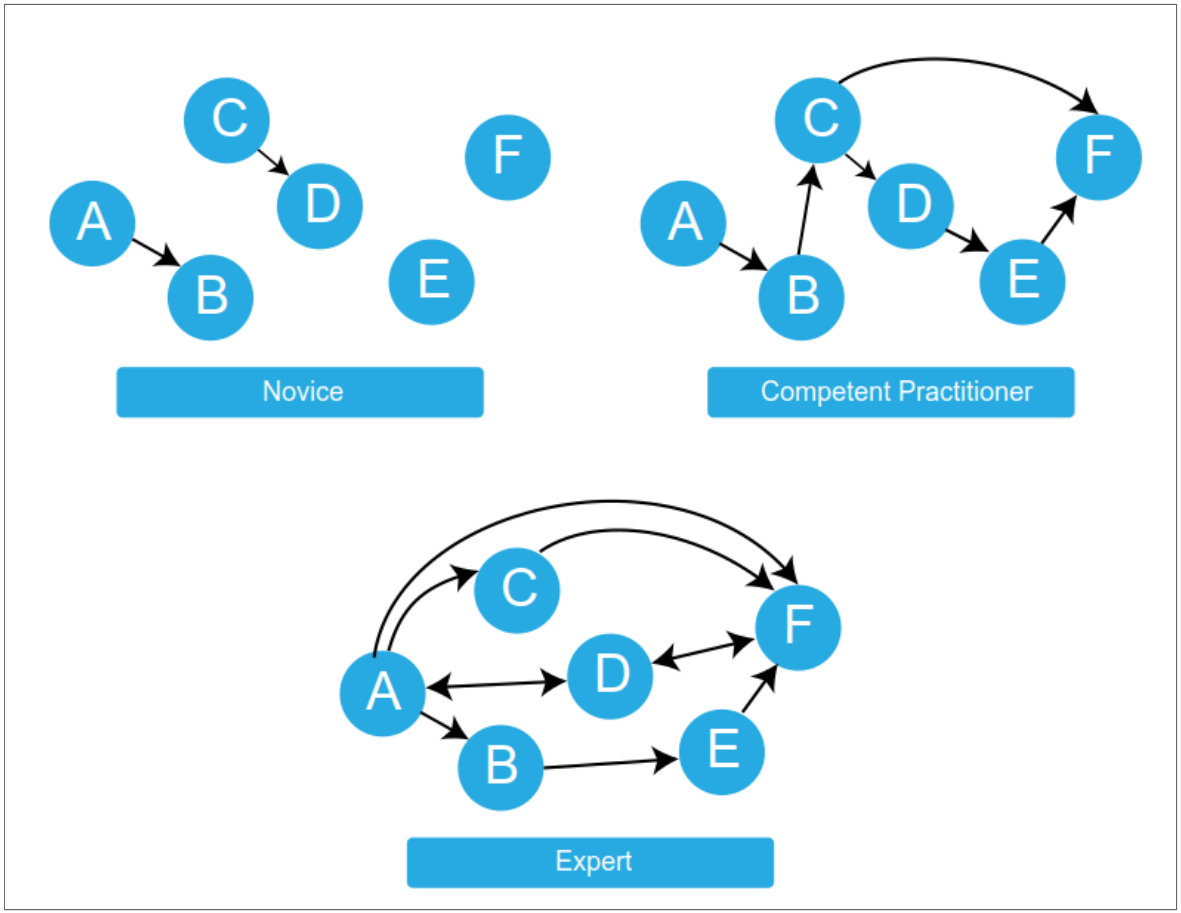
- A *novice* has a minimal mental model of surface features of the domain. Inaccuracies based on limited prior knowledge may interfere with adding new information. Predictions are likely to borrow heavily from mental models of other domains which seem superficially similar.

Mental models



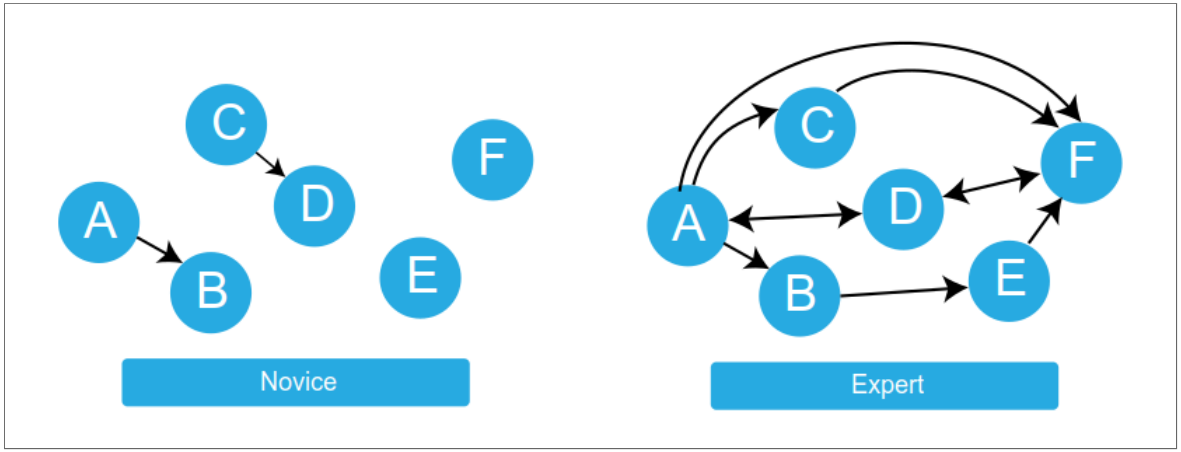
- A *competent practitioner* has a mental model that is useful for everyday purposes. Most new information they are likely to encounter will fit well with their existing model. Even though many potential elements of their mental model may still be missing or wrong, predictions about their area of work are usually accurate.

Mental models



- An *expert* has a densely populated and connected mental model that is especially good for problem solving. They quickly connect concepts that others may not see as being related. They may have difficulty explaining how they are thinking in ways that do not rely on other features unique to their own mental model.

Expertise, mental models and teaching: expert blind spot



Because your learners' mental models will likely be less densely connected than your own, a conclusion that seems obvious to you will not seem that way to your learners. It is important to explain what you are doing step-by-step, and how each step leads to the next one. Mind The Gap
The problem with this is that when you are used to going from A to F in a single leap, it can be very hard to remember that novices need to go through steps B and C before they can understand the connection between A and F. Experts are frequently so familiar with their subject that they can no longer imagine what it is like to not understand the world that way. This phenomenon is known in the literature as an **expert blind spot**.

Exercise: expert blind spot

1. Is there anything you are learning how to do right now? Can you identify something that you still need to think about, but your teacher can do without thinking about it?
2. Think about the area of expertise you identified for yourself earlier. What could a potential awareness gap be?

This exercise should take about 5 minutes.

Formative assessments

Any instructional tool that generates feedback that is used in a formative way can be described as *“formative assessment.”*
We can use formative assessments eg. to tease out misconceptions using well-designed exercises or multiple choice questions as:

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Q: what is 27 + 15 ?
a) 42
b) 32
c) 312
d) 33
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The correct answer is 42, but each of the other answers provides valuable insight.

Exercise: identify the missconecptions Choose one wrong answer and write in the Etherpad what misconception is associated with that wrong answer.
Think how could you design a similar question for your lessons.
This discussion should take about 5 minutes.

Formative assessments

Formative assessments allow us as instructors to adapt our instruction to our audience. What options do we have if a majority of the class chooses:

1. mostly one of the wrong answers?
2. mostly the right answer?
3. an even spread among options?

Memory and Cognitive Load

Question:

- What is cognitive load and how does it affect learning?

Objectives

- Remember the quantitative limit of human memory.
- Evaluate cognitive load associated with a learning task.

For our purposes, human memory can be divided into two different layers.

- The first is called **long-term**. It is where we store persistent information like our friends' names and our home address.
- Our second layer of memory is called **short-term**. This is the type of memory you use to actively think about things and is often called working memory. It is much faster, but also much smaller: the average adult's short-term memory could hold 7±2 items for a few seconds before things started to drop out

Exercise: testing our short-term memory

This website implements a short test of working memory: **https://miku.github.io/activememory/**
What was your score? If you are comfortable, share your answer in the Etherpad.
This exercise should take about 5 minutes.

Attention is a Limited Resource: Cognitive Load

While many people believe that they can “multi-task,” the reality is that attention can only focus on one thing at a time. Adding items that demand attention adds more things to alternate between attending to, which can reduce efficiency and performance on all of them.

One way to manage cognitive load as tasks become more complex is by using guided practice: creating a structure that narrowly guides focus on specific skills and knowledge in a stepped fashion, with feedback at each step before transferring attention to a new feature.