But They Said They Knew This!

I recently taught Research Methods in Decision Sciences for the first time. On the first day of class, I asked my students what kinds of statistical tests they had learned in the introductory statistics course that is a prerequisite for my course. They generated a fairly standard list that included T-tests, chi-square, and ANOVA. Given what they told me, I was pretty confident that my first assignment was pitched at the appropriate level; it simply required that students take a data set that I provided, select and apply the appropriate statistical test from those they had already learned, analyze the data, and interpret the results. It seemed pretty basic, but I was shocked at what they handed in. Some students chose a completely inappropriate test while others chose the right test but did not have the foggiest idea how to apply it. Still others could not interpret the results. What I can’t figure out is why they told me they knew this stuff when it’s clear from their work that most of them don’t have a clue.

Ambrose et.al. (2010) How Learning Works: 7 Research-Based Principles for Smart Teaching
How Does Prior Knowledge Affect Learning?

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Outcomes

By the end of this session, you should be able to:

• Identify four problematic types of prior knowledge (PK)

• Generate examples of each from your own experience

• Discuss strategies to address each situation
Students ≠ blank slates

• They come into our classrooms with facts, frameworks, mental models, attitudes, beliefs, assumptions, etc.

• They build on and interpret incoming information through the lens of their existing knowledge.

“The most important single factor influencing learning is what the learner already knows.”

D.P. Ausubel (1968)
LEARNING PRINCIPLE: Students’ prior knowledge can help or hinder learning.

Inaccurate prior knowledge
Some of what students know may be just plain wrong.

Inaccurate prior knowledge can distort new learning.

“It’s not what we don’t know that gives us trouble. It’s what we know that ain’t so.”

Will Rogers
Misconceptions can be highly persistent. Why?

• reinforced over time and across contexts

• may include accurate—as well as inaccurate—elements

• may permit some successful explanations and predictions
Inactive Prior Knowledge
Scenario: A general wishes to capture a fortress. Roads radiate outward from the fortress, but all of them have been mined so that if a large force travels on them, it will detonate the mines. A full-scale direct attack is therefore impossible.

Solution: Divide the army into small groups, send each group to the fortress on a different road, and have the groups converge simultaneously on the fortress.

(adapted from Gick and Holyoak, 1980)
But they did not think to apply the same reasoning to this analogous problem

Scenario:
A patient has a malignant, inoperable tumor. If the tumor is not destroyed, the patient will die. Fortunately, there is a kind of ray that can be used to destroy the tumor. If the ray reaches the tumor at sufficiently high intensity, the tumor will be destroyed. However, if the ray is used at high intensity, it will damage surrounding tissues.

Question:
What type of procedure might be used to destroy the tumor with the rays, and at the same time avoid destroying healthy tissue?

(adapted from Gick and Holyoak, 1980)
In other words, students possessed relevant prior knowledge, but they didn’t use it . . . because students do not necessarily tap into relevant prior knowledge.
Insufficient Prior Knowledge
If students lack critical background knowledge and skills, it undermines subsequent learning, e.g. . . .

<table>
<thead>
<tr>
<th>If students don’t know . . .</th>
<th>. . . they can’t effectively . . .</th>
</tr>
</thead>
<tbody>
<tr>
<td>colonial history</td>
<td>analyze contemporary geopolitics</td>
</tr>
<tr>
<td>differential equations</td>
<td>solve complex engineering</td>
</tr>
<tr>
<td>principles of visual</td>
<td>problems</td>
</tr>
<tr>
<td>hierarchy</td>
<td>create typographical designs</td>
</tr>
<tr>
<td>??</td>
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</tr>
</tbody>
</table>
Thus, it’s important for instructors to know what students do and don’t know, in order to . . .

• Fill gaps
• Reinforce weak areas
• Build on a strong foundation
Because we know what happens when you build on a weak foundation.
Two things make assessing students’ prior knowledge tricky.

1. Students often overestimate their own abilities (Kruger and Dunning, 1999). So asking your students “Do you know X?” may yield unreliable information.

2. There are different types and levels of knowledge.
   Knowing *what* ≠ knowing *why*
   Knowing *how* ≠ knowing *when*

Just because students have one kind of knowledge, does not mean they have the others.
So, for example, students might be able to...

- define Newton’s Second Law, but not apply it.

- create a typographical design, but not explain their design decisions.

- describe different statistical tests, but not identify which to apply in the context of a problem.

- apply a formula, but not explain the concept from which it is derived.
Inappropriate Prior Knowledge
From *Fish is Fish*
by Leo Leonni
Knowledge may be appropriate for one context and inappropriate for another.

If students apply prior knowledge that is inappropriate for a new learning context, it can:

- impede learning
- distort understanding
- inhibit performance
Students may, for example:

Misapply **disciplinary conventions**
- E.g., apply expressive writing conventions to lab reports

Act on inappropriate **cultural assumptions**
- E.g., refrain from asking questions so as not to insult the teacher

Carry **analogies** too far
- E.g., over-analogize from skeletal muscles to heart muscles
Let’s Revisit the Story . . .

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Brainstorm strategies

What are some ways you can

• **address** inaccurate knowledge?

• **activate** prior knowledge?

• **identify** insufficient knowledge?

• help students avoid applying prior knowledge **inappropriately**?
LEARNING PRINCIPLE: Students’ prior knowledge can help or hinder learning.

As instructors, we need to:

1. Find out what students know and don’t know.

2. Activate relevant prior knowledge.

3. Identify & fill gaps in students’ insufficient knowledge.

4. Identify inappropriate applications of prior knowledge.

5. Actively work to correct inaccurate knowledge.
Final Questions?

Final Thoughts?