Worked Examples as Coaching: Designing for Independent Learning

James Brooks

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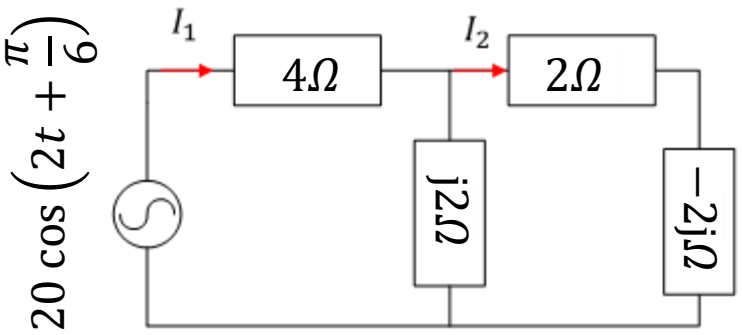
Three ‘modes’ of educating

I’m Stuck!

Compute the average power of each component:



Three ‘modes’ of educating

Telling

“Do this next”

“Start by calculating …”

“Here’s the equation you need”

“There is a mistake here”

Coaching

“How are these similar to previous questions?”

“What has worked before?”

“What do you need to know?”

Encouraging

“You’ll get it, just stick with it”

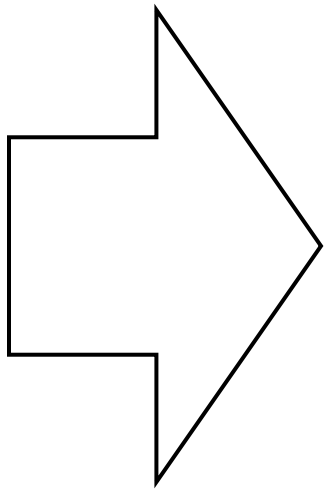
“Keep going”

“You got this”

“I know you can figure this out without me”

Literature

- Cognitive load theory
- Discovery learning
- Problem based learning
- Productive failure
- Cognitive apprenticeship
- Rosenshine's principles



Structure activities that get students thinking deeply, with two-way interaction, and enough support to keep them motivated on the task

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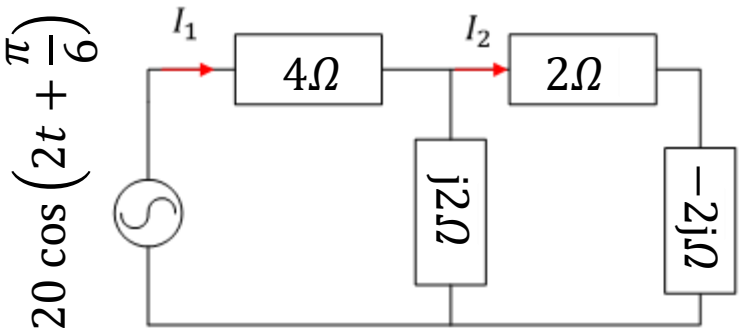
What do students need to know? What should we tell them?

Compute the average power of each component:



1. **Understand some concepts** (current, voltage, power, etc)
2. **Use some techniques** (KVL, KCL, series and parallel elements, current divider, etc)
3. **Pick which techniques to apply in what order** (simplify first then current divider then …)
4. **Apply the techniques to the question** (to simplify this circuit I need to …)

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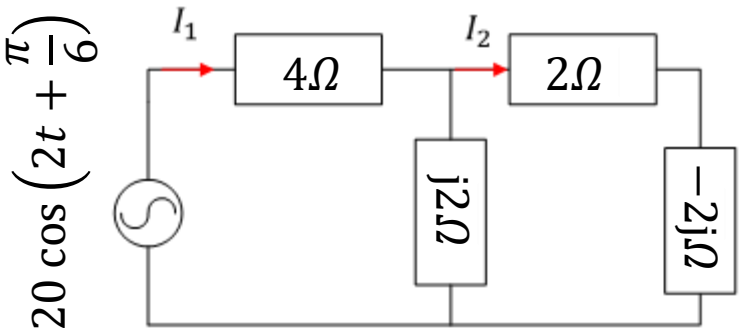
Compute the average power of each component:



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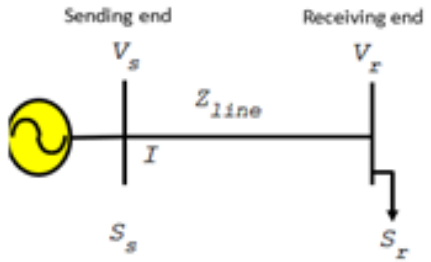
Worked Example

Find the Complex power at the sending end given:

$$V_{r.pu} := 1 + i \cdot 0$$

$$S_{r.pu} := 0.5 + i \cdot (-0.01)$$

$$Z_{line.pu} := 0.01 + i \cdot 0.1$$



$$I := \left(\frac{\overline{S_r}}{V_r} \right) = (5000 + 100 \cdot i)\ A$$ from S=VI*

$$V_{line} := I \cdot Z_{line} = (0.04 + 0.501 \cdot i)\ kV$$ from V=IZ

$$V_s := \left(V_r + V_{line} \right) = (10.04 + 0.501 \cdot i)\ kV$$ from KVL

$$S_s := V_s \cdot \overline{I} = (50.2501 + 1.501 \cdot i)\ MW$$ from S=VI*

Case Study 1 – discussion forms

(1) identify high-quality sources;

(2) extract and explain the technical content of a paper;

(3) find commonality, disagreement, and gaps in the literature;

(4) critique and extend their peers' contributions

Telling

"How to use Scopus"

"Judging quality of a paper"

"Why we have literature reviews"

"How to compare papers"

Coaching

Weekly video tutorial, coaching questions when reviewing the cohort's submission that week.

Encouraging

In the tutorial and via weekly email.

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Extra slides

How to create great worked examples

1. Provide two or more varied context worked examples
2. Fade from examples to questions
3. Encourage self-explanation (why questions and comparisons)
4. Occasionally use examples that make and correct common errors

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4. Worked Examples

"Worked examples along with engagement techniques [...] lead to more effective and efficient learning"

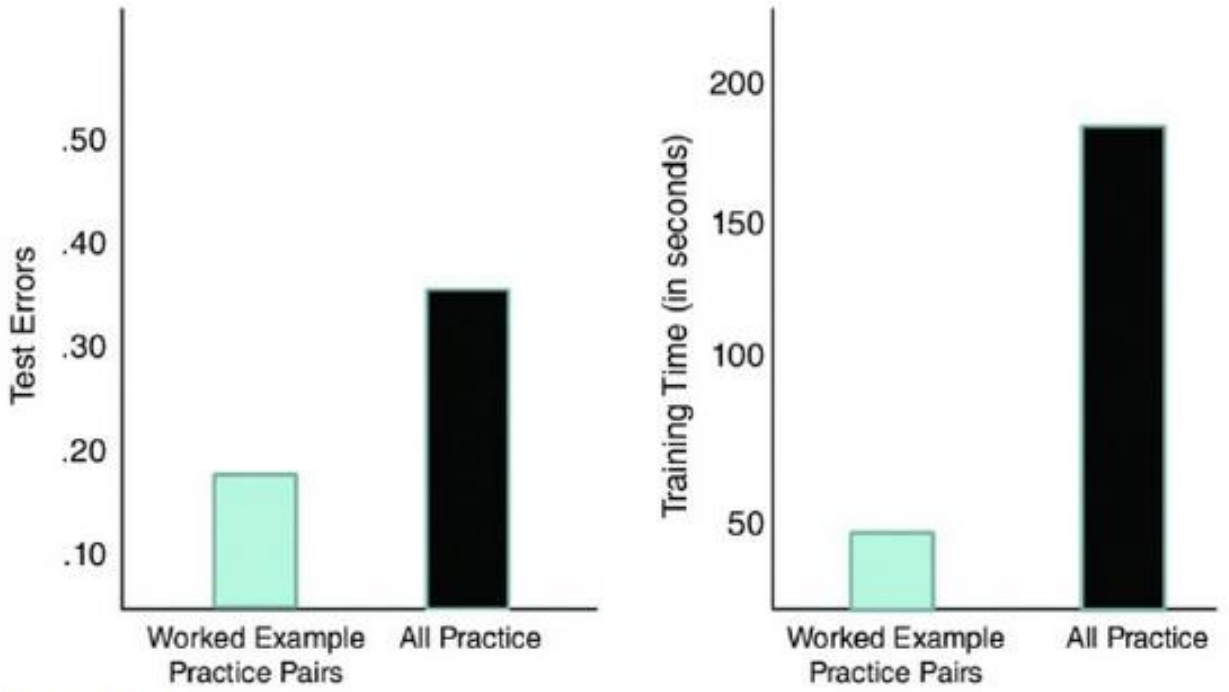

Figure 12.3 Worked Example Problem Pairs Result in Faster and Better Learning.

Based on data from Sweller and Cooper, 1985.

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4. Worked Examples

Provide two or more worked examples with a **varied context**

Find the Complex power at the sending end given:

$V_{r.pu} := 1 + i \cdot 0$

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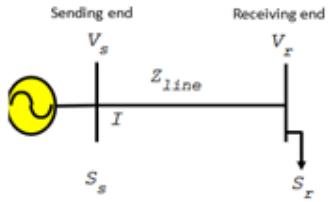
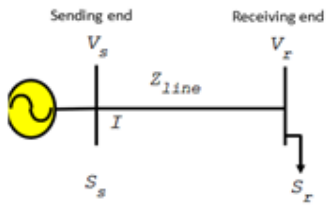


Find the Complex power at the sending end given:

$V_{r.pu} := 1 + i \cdot 0$

$S_{r.pu} := 0.7 + i \cdot (-0.06)$

$Z_{line.pu} := 0.03 + i \cdot 0.2$



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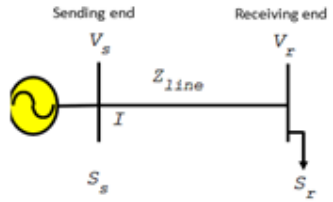

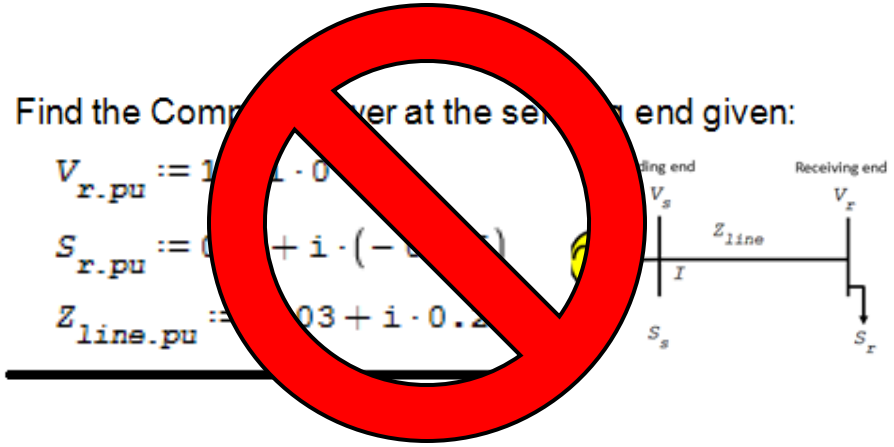

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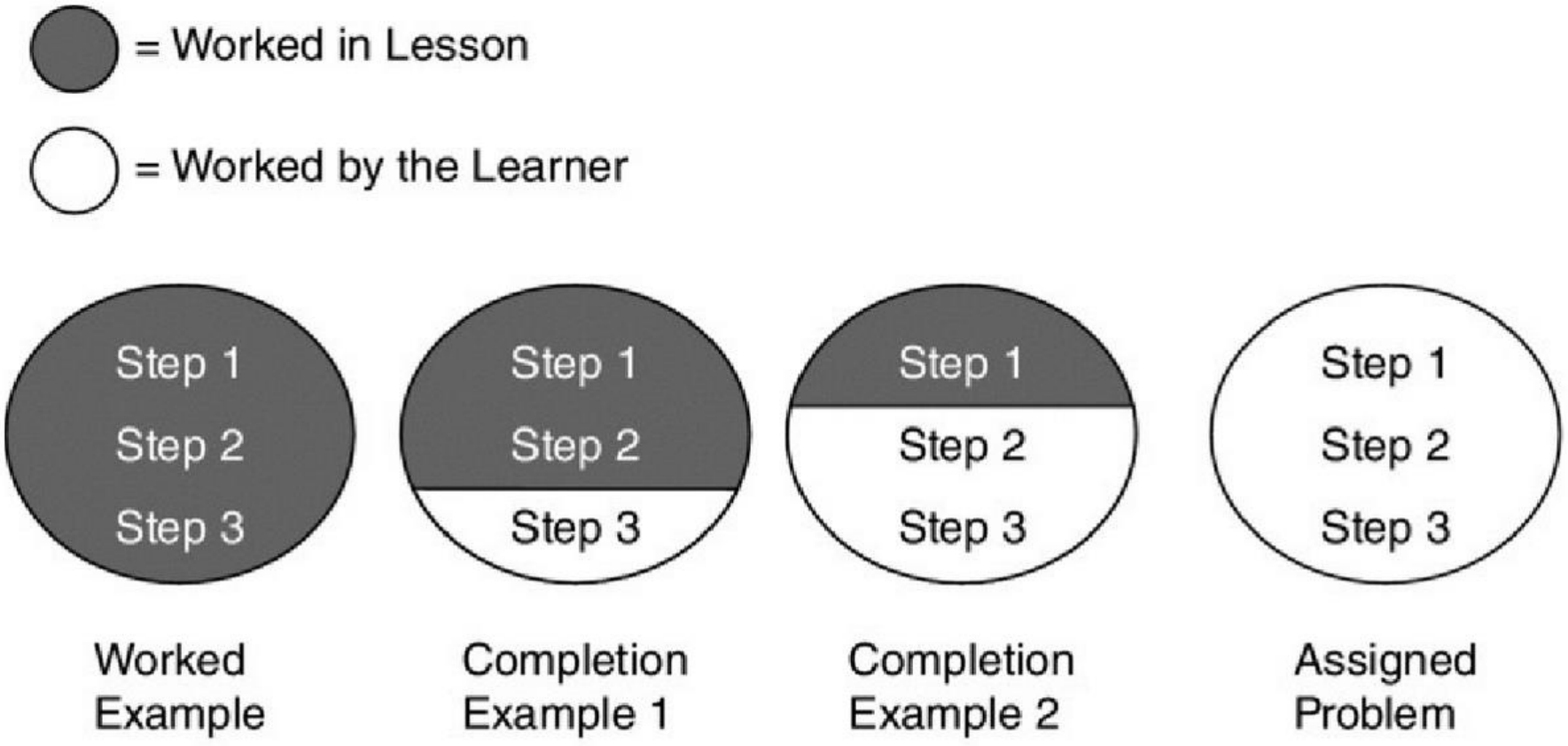

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4. Worked Examples

Encourage self-explanation

Figure 10-6. Two Worked Examples; Version B Adds a Question

Example Version A:

Find the area of a circle when the diameter is 8

Step 1. Formula: $A = \Pi R^2$
Step 2. Radius = 8/2 = 4
Step 3. A = 3.12 times 16
Step 4. A = 49.92

Example Version B:

Find the area of a circle when the diameter is 8

Step 1. Formula: $A = \Pi R^2$
Step 2. Radius = 8/2 = 4
Step 3. A = 3.12 times 16
Step 4. A = 49.92

QUESTION:

In step 2, why was 8 divided by 2?
A. Because the radius must be squared
B. Because the radius is half the diameter
C. Because pi equals 4
D. Because 4 is the square root of 16

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Support learners to explain why incorrect solutions are wrong

2. The International Space Station travels at an average speed of 7.66 km/s. One orbit around the Earth takes around 5400 seconds. How far will it travel in that time?

Tim's answer	Your answer
$s = 7.66\,km/s \quad t = 5400s$ $s = \frac{d}{t} \qquad d = \frac{5400}{7.66}$ $d = 705m$	

What mistake(s) has Tim made?

https://educationendowmentfoundation.org.uk/news/eef-blog-working-with-worked-examples-simple-techniques-to-enhance-their-effectiveness

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