2.11 Engineering: Trust, but Verify the Circuit

Does It Actually Work? Checking AI's Circuit Explanations Against Real Measurements

Subject: Physics / Technology (Basic Engineering) · **Target Group:** 8 (age 13–14) · **Duration:** 1 double lesson · **AI:** Learning **WITH** AI

AI-related competencies (DUAL.AI.TEACHer Framework) – teacher level	**Subject-specific learning objectives – student/learner level**
AF-TL-2b *(AI foundations and applications × Teaching & Learning, Level 2 – Reflective Implementation):* "Teachers can organise lesson elements that embed AI use with clear pedagogical roles and strategies to verify the output elements." **AF-FC-2b** *(AI foundations and applications × Facilitating Learners' (AI) Digital Competence, Level 2 – Reflective Implementation):* "Teachers can implement guidance that helps learners develop practical AI skills, adapting the tasks to learners' prior knowledge and the AI tools available."	By the end of the lesson, participants can: • build a simple series or parallel circuit from a diagram using a breadboard; • measure voltage, current and resistance using a multimeter; • calculate expected values using Ohm's Law and compare them with real measurements; • distinguish between a measured value, a calculated/predicted value, and an AI-generated explanation; • identify errors in an AI-generated circuit diagram or explanation by testing it against real measurements; • formulate prompts that require AI to show its calculation steps so they can be checked.
Take-home message: An AI explanation of a circuit can sound completely confident and still be wrong. The only way to know whether a circuit actually behaves as claimed is to measure it and check the numbers against the underlying physics — not to trust confident-sounding text.	

Content

Engineers and physicists never simply trust a circuit diagram or a written explanation of how a circuit works. Instead, they build it, measure it, and calculate the expected values from first principles — Ohm's Law and Kirchhoff's laws. A diagram can look entirely correct on paper, but only a real measurement confirms whether current actually flows the way it is claimed to.

A simple series circuit — a battery, a resistor and an LED — provides a useful case study. Ohm's Law ($V = I \times R$) predicts exactly how much current should flow for a given voltage and resistance. Because the components' real-world behaviour can vary slightly (tolerance, internal resistance, temperature), the measured current is usually close to, but not always identical to, the calculated prediction — which is itself a useful lesson in the difference between a model and reality.

AI tools can now generate circuit diagrams and explanations of circuit behaviour in seconds. These explanations often sound fluent and confident, and may even include a full Ohm's Law calculation — but they can also contain real errors: an incorrect resistor value, a broken or incomplete loop, a component connected with the wrong polarity, or a plausible-sounding but physically impossible claim about current flow.

This is a well-documented weak spot: language models are not calculators, and they can produce technical-sounding explanations that do not hold up when a circuit is actually built and tested. A confident tone is not evidence that a technical claim is correct.

Students therefore need to distinguish between three levels of certainty:

Measurement – the value a multimeter actually reads on the real, built circuit.

Calculation – the value predicted from Ohm's/Kirchhoff's laws using the known component values.

Claim – what an AI tool states about the circuit's behaviour, which must be checked against the other two before it can be trusted.

Lesson plan

Phase	Time	Activity
Hook	10 min	Show an AI-generated explanation of a simple LED circuit that contains a hidden error (e.g. a wrong resistor value). Students guess whether it is correct and why.
Input	10 min	Introduce Measurement – Calculation – Claim and practise Ohm's Law on a simple worked example.
Exploration	15 min	Students build a simple series circuit on a breadboard and measure voltage, current and resistance without AI.
Adaptation 1	20 min	AI predicts/explains the circuit's behaviour from a diagram or description alone. Students compare its claims to their own measurements and calculations.

Adaptation 2	20 min	Students give AI exact component values and require a step-by-step Ohm's Law calculation. They compare the two AI responses.
Reflection	25 min	Students transfer the same verification habit to another domain, such as an AI fitness or health calculator.

Guiding questions: from AI output to classroom-ready activity

- **Hook — Show an AI-generated explanation of a simple LED circuit containing a hidden error (e.g. a resistor value too low to protect the LED):**
  - *Discussion question:* "Does this explanation sound correct? How would we actually check?"
  - *Introduce the problem:* "An explanation can sound confident and still be wrong — what would prove it right or wrong?" Key principle for this lesson (measurement over confident wording)
  - Measurement → calculation → claim (to be checked)
- **Input — Worked example with a simple series circuit (battery, resistor, LED):**
  - Provide statements about the circuit that need to be categorised into measurement, calculation, claim. Example:
  - The multimeter reads 9 mA of current through the circuit – *measurement*
  - Ohm's Law predicts 9.1 mA for these component values – *calculation*
  - The AI states that this circuit "will work reliably in any configuration" – *claim (to verify)*
- **Exploration — Group work. Building and measuring a real circuit:**

Materials and steps for each group, e.g.:

A) A circuit diagram showing a battery, one resistor and one LED in series.

B) A breadboard, jumper wires and the listed components.

C) A multimeter and a short reference sheet on how to measure voltage, current and resistance.

D) A resistor colour-code chart and the LED's forward-voltage rating.

Students fill out a worksheet answering: What do we measure? What does Ohm's Law predict? Where do the two differ, and by how much?

- **AI predicts/explains the circuit:**

Prompt used by students: Given a circuit with a 9V battery, a 470Ω resistor and a red LED in series, explain how much current will flow and why. Show your reasoning.

Students annotate the AI response:

  - Matches our measurement
  - Matches our calculation
  - Unsupported / needs checking
- **AI revises its work using stricter requirements:**

Improved prompt: Recalculate the current step by step using Ohm's Law, showing the formula and each substituted value. State any assumptions you make about the LED's forward voltage drop, and flag anything that would need to be measured to confirm.

Compare:

Version 1 → Version 2

Find:

- one figure that became more precise;
- one assumption AI made explicit;
- one value that now matches your measurement;
- one claim that still needs independent checking.

- **Reflection/Transfer of knowledge**

Show a short, classroom-appropriate example of an AI-generated fitness, nutrition or health calculation (e.g. “your recommended daily calorie intake is…”).

Discussion question:

- Based on the key principles from this lesson, what here is a measurement, a calculation, and a claim?
- If an AI answer sounds confident and uses correct-looking formulas, does that mean the result is trustworthy?

Final individual reflection:

Students complete:

1. A technical claim becomes trustworthy when…
2. Before trusting an AI's explanation of how something works, I should…
3. AI can sound confident about a technical process, but…

Materials

- Projector/interactive whiteboard.
- Breadboards, jumper wires, resistors, LEDs and battery packs (one set per group).
- Multimeters (one per group).
- Resistor colour-code chart and LED forward-voltage reference sheet.
- Measurement–Calculation–Claim mini worksheet.
- Circuit diagram worksheet and source-analysis worksheet.
- An AI-generated circuit explanation containing a deliberate error, for the hook.
- Student devices with access to an approved generative AI tool.
- AI prompt and comparison worksheets for Rounds 1 and 2.
- Example of an AI-generated fitness/health calculation for the reflection.

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