



TAQYEEM STEAM — WORKED EXAMPLE

“How can we design a building that stays cool without electricity?”

Domain: Architecture · Physics (thermodynamics) · Cultural heritage · Environmental engineering

Level: Grades 9–10 · Ages 14–16

Alignment: Vision 2030 (sustainability, heritage) · SDG 7 (clean energy) · SDG 11 (sustainable cities) · SDG 13 (climate action)



How a conventional class would do this (the thing we replace)

The teacher shows a diagram of a building cross-section, explains U-values and insulation on a slide, and students copy notes. A worksheet asks them to calculate heat loss from a formula they have been given. Nobody touches a material. Nobody steps outside. Nobody asks why the old building down the street never needed air conditioning.

How Taqyeem STEAM does it — stage by stage

Stage 1 — Socratic Launch (inquiry, not lecture)

The mentor does not explain passive cooling. They ask:

*"Walk past a traditional building and a modern glass tower on a hot afternoon. Which one feels cooler near the wall? Why do you think that is?
What did builders do before air conditioning existed? Could those solutions still work today?"*

Students must form a hypothesis before any instruction is given:

- "I think the thick mud walls absorb heat slowly, so the inside stays cool during the day."
- "I think the courtyard creates shade and pulls cool air up from below."
- "I think the small windows face away from the sun on purpose."

This is the think-like-an-architect step: observe, question, hypothesise — before the textbook opens.

Stage 2 — Investigation & Building (project work)

The student runs a three-track investigation:

Track A — Materials experiment

- Build three small box models: (1) thin cardboard (modern construction), (2) thick foam/clay (traditional mud wall), (3) cardboard with foil lining (reflective modern).
- Place a thermometer probe inside each. Expose to a heat lamp or direct sun for 30 minutes.
- Record internal temperature every 5 minutes. Plot on a single graph.
- Calculate surface-to-volume ratio for each model and compare to temperature results.

Track B — Architectural research & field visit

- Research three traditional Arabian passive-cooling features: the Malqaf (wind catcher), the Mashrabiyya (latticed wooden screen), and the sahn (interior courtyard).
- Visit or photograph a traditional building in their area. Sketch the layout and identify which passive features are present.
- Interview an elder or heritage expert: "What was it like inside this building in summer before air conditioning?"

Track C — Redesign challenge

- Take a standard rectangular "modern box" floor plan (provided as a template).
- Redesign it to incorporate at least two passive-cooling strategies.
- Justify every design decision with evidence from Tracks A and B.

The elder interview is where the social-science strand enters. The student's community knowledge — grandparents describing how a courtyard house felt in July — is treated as primary evidence, not anecdote.

Stage 3 — Iteration (where real engineering thinking is built)

The first redesign almost always fails the student's own hypothesis. Common problems:

- The courtyard is too small and creates no meaningful air circulation.
- The Mashrabiyya blocks too much light, making the room unusable.
- The north-facing windows still let in afternoon western sun.

The mentor asks: "What does your data say? What would you change, and why?" The student revises the design and re-tests the model.

The iteration log is the single most compelling element for a university architecture or engineering portfolio — it shows design thinking, not just a polished final drawing.

Stage 4 — Assessment at Service of Learning (the differentiator)

The student writes up the project. Their write-up may open with the story of the visit — the smell of the old courtyard, what the elder described — before stating their findings.

A standard rubric marks this down: "background too long, put your results first." Taqyeem STEAM's assessment separates the two dimensions:

- Engineering reasoning (hypothesis, method, data, conclusion): scored on rigour.
- Rhetorical structure (how the story is told): named as a valid cultural choice, not penalised.

The student keeps their own voice for their ePortfolio, and is coached to produce a technical-first version for university submissions — so they have both, and understand when each is appropriate.

The project runs through five lenses:

- Self-assessment — student rates their own design against the rubric first
- Peer review — another student critiques using the same criteria
- Teacher assessment
- Mentor assessment — applying the culturally responsive standard formally
- AI check — for documentation completeness and iteration log coverage

Stage 5 — Competition & ePortfolio (external validation)

The finished project — temperature data, scale drawings, redesign, iteration log, elder interview transcript, and final reflection — is entered into the Taqyeem STEAM online competition.

Whether it places or not, it is now an externally validated, documented artefact: a buildable design backed by real experimental data and community research.

Stage 6 — University Application Payoff (the outcome)

When this student applies to architecture, engineering, or sustainability programmes abroad, they do not write a vague "I am passionate about design." They attach:

- A documented investigation comparing three building materials with real temperature data.
- A culturally grounded redesign of a residential building incorporating traditional passive-cooling strategies.
- An iteration log showing design decisions, failures, and revisions.
- A primary-source elder interview treated as legitimate evidence.

That is precisely what selective architecture, civil engineering, and sustainable design programmes — and their scholarships — are looking for. The student built genuine design reasoning along the way, not just a line on a CV.

One project, four problems solved: Socratic inquiry instead of memorising; real experimental and design work instead of nothing to show; culturally responsive assessment instead of penalised reasoning; and a competition-validated, university-ready portfolio.