Using ChatGPT to visualise lecture concepts

Daria Frank

17th September 2025

Concepts in STEM

- Many concepts are abstract and hard to picture:
  - visualising electric/magnetic field lines around charges or coils (Physics)
  - plotting predator–prey cycles (Lotka–Volterra equations) interactively (Biology, Maths)
  - showing 2D/3D landscapes with local minima and gradient descent paths (Engineering, Maths)
  - simulating concentration gradients and how they evolve over time (Physics, Chemistry)
- Students often struggle to see what is happening
- Often leads to rote learning before real understanding develops

Toolboxes and visualisation to help understanding

What if we could turn understanding difficult concepts into a game?...

- Small, focused programs for specific concepts
- Students can adjust parameters and see outcomes instantly
- Turns theory into “something you can play with”
- Encourages experimentation and intuition-building
- Interactivity deepens understanding

Python and ChatGPT

- Reliable at turning clear pseudocode into Python
- Accelerates the creation of small teaching tools
- Frees time for focusing on concepts rather than coding minutiae
- Often anticipates invalid parameters and includes error handling
- Produces runnable code quickly, with sensible defaults
- Useful for generating multiple variants of a program in seconds
- Still requires checking and occasional fine-tuning by the instructor

Example: Internal gravity waves in stratified fluids

- Stratified fluid: density of water increases with depth
- Ray reflection behaves differently from familiar light rays:
  - Light waves: incidence angle = reflection angle
  - Internal gravity waves: inclination to the vertical must remain fixed, i.e., either vertical or horizontal direction of the ray is reversed
- Reflection, especially from complex geometries, is difficult to visualise and understand

Pseudocode and Python implementation in ChatGPT

- Start with structured pseudocode (clear steps, parameters, conditions)
- Provide this directly to ChatGPT
- ChatGPT translates pseudocode $\rightarrow$ runnable Python
- Generated code often includes sensible defaults and error handling
- Instructor reviews and adjusts as needed before sharing with students
- Output: ready-to-use toolbox for visualisation and exploration

Conclusions

- ChatGPT can enrich lectures by creating interactive visualisation tools on demand
- Saves preparation time and frees teachers to focus on explanation and discussion
- Empowers students to experiment rather than passively receive information
- Similar visualisation approaches extend beyond STEM:
  - Mapping character interactions in literature
  - Generating timelines for historical events
  - Visualising patterns and symmetry in art and music