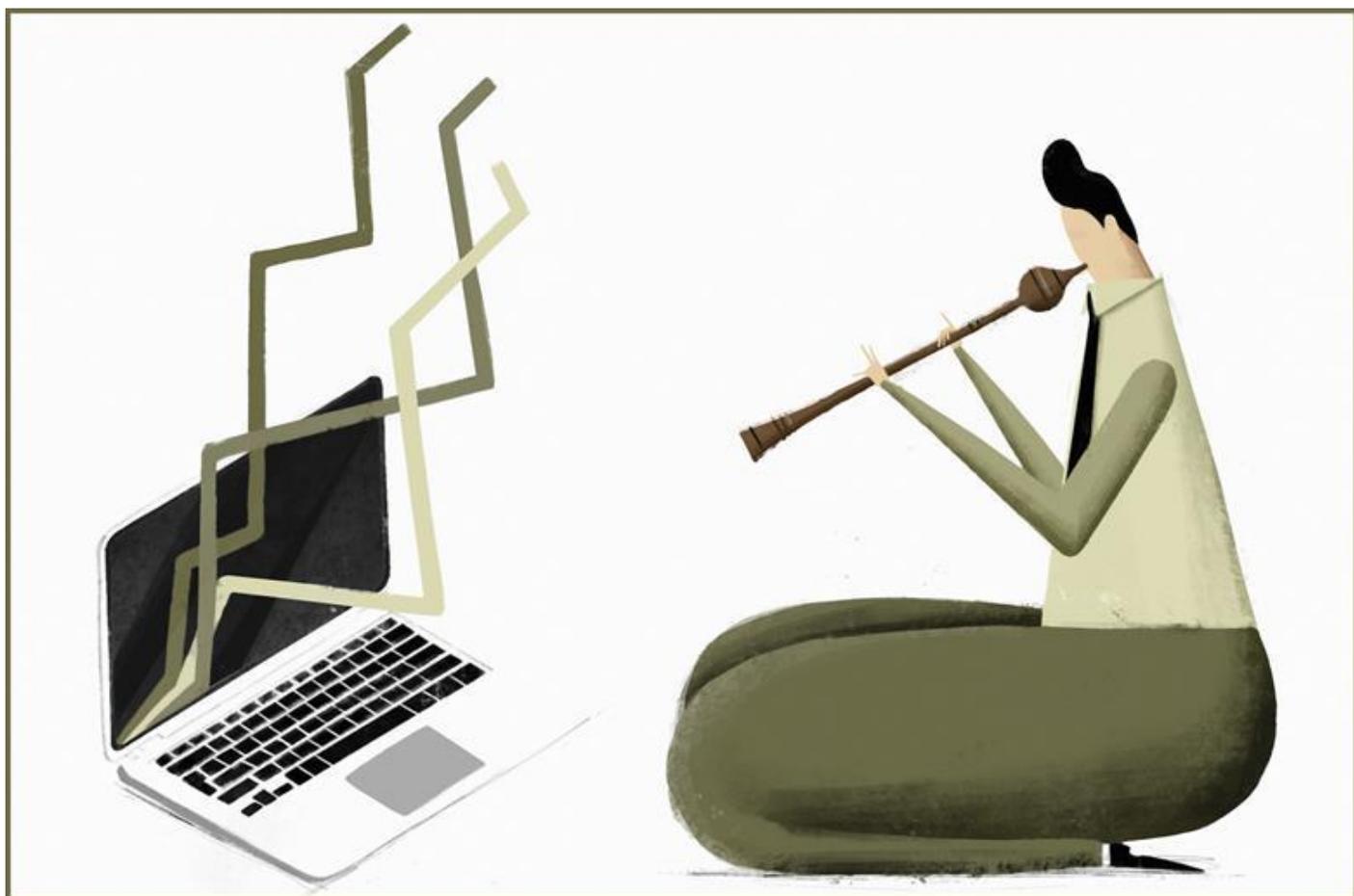


Rationalising rates

By [Fraser Scott](#) | 19 November 2020

What to look out for graphically when teaching reaction kinetics



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Help your students charm graphs in chemical kinetics with these teaching tips

Chemists often represent the underlying models of chemical kinetics graphically, such as when plotting concentration v time or rate v time. Studies have shown that students have difficulties understanding rate and rate constant, and that graphical representations often make it more challenging.

A [recent study](#) from researchers in the US investigated the relationship between students' models of reaction rate, and the graphical representations they use to describe them.

The researchers interviewed 15 first-year undergraduates. They presented each student with three prompts relating to the same simple chemical reaction and gave the reactant's initial concentration. Each prompt asked students to draw a graph describing the reaction rate, but using different axes: [reactant] v time; [product] v time; and rate v time.

Common graphing mistakes

Analysis found limited variation in the way students described and represented their models for both concentration v time prompts. However, there were multiple models constructed for the rate v time prompt. While all the students' rate v time graphs showed a decrease over time, there was substantial variation in the starting and final positions of the line, and its overall shape.

The challenges associated with the rate v time graph are perhaps not surprising. The other graphs only require students to consider general features, such as reactant consumed or product formed. For the rate v time graph, students must also consider the effect that the changing reactant concentration has on rate, and then translate this mathematical relationship into a graphical representation.

Interestingly, although students' graphs of rate v time were variable, the students used similar chemical and mathematical ideas in their explanations.

Teaching tips

In this study, investigators revealed students' reasoning about reaction rate through an analysis of the graphical representations they chose to describe their underlying models of chemical kinetics. If you incorporate this into your own practice you should consider a number of points:

- Graphs within chemical kinetics do not all present the same challenge for students. Rate v time graphs are more difficult compared to concentration v time graphs. Spend more time on rate v time graphs to ensure students' understanding.
- Look at a variety of graphs ([reactant], [product] and rate v time) describing the same chemical situation. This could secure students understanding. Comparing and contrasting each graph could further help.
- Assessing students' understanding of chemical kinetics solely through graphs may be misleading. For example, this study found that students' explanations of rate v time were sound, but representing this graphically was a challenge. A combined approach of written and graphical assessment could reveal more.

- This study suggests that students often conflate the slope of a graph with reaction rate, ie a linear slope always represents a constant reaction rate in any graph of chemical kinetics.
- You could easily incorporate the prompts used in this study into your teaching to assess your students' understanding by extracting them from the published paper on the study.
- The [supporting information](#) with the paper also provides some useful hints and tips related to graphical representations of chemical kinetics for your teaching practice.

References

J-M G Rodriguez, A R Harrison and N M Becker, *Journal of Chemical Education*, 2020, DOI: [10.1021/acs.jchemed.0c01036](https://doi.org/10.1021/acs.jchemed.0c01036)