



Supplement of

Development and Iterative Design of an educational game “Magma Pop” to teach undergraduate fractional crystallization concepts

Sriparna Saha et al.

Correspondence to: Sriparna Saha (sriparna.saha@canterbury.ac.nz)

The copyright of individual parts of the supplement might differ from the article licence.

Supplement Magma Pop

Feedback from focus group

- Magma Pop can be extremely useful for learning mineral formulae.
- Add opportunities for critical reflections through inclusion of characters or pop up messages.
- Survey was not useful.
- Magma Pop has the potential to cater different learning styles.
- Instructions can be clearer by addition of pop-up messages or animated tutorials.
- Magma Pop can be made more engaging through introduction of characters and stories.
- Additional/pop up messages and introduction of characters can make the game more reflective.

Sample transcript from evaluation- **Pre magma pop**

Speaker 1: Could you talk to me a little bit about your understanding of fractional crystallisation?

Speaker 2: So my understanding pretty much comes from [the Geology course]. So did you want me to talk about how the process?

Speaker 1: Yes

Speaker 2: Yeah, no, fractional crystallisation is basically where crystals form in the melt and as they get removed from the melt and as they crystallise and they get sink, you no longer count the portion of the melt that is, sorry, I'm getting all jumbled up. Basically, I think you have the crystals and the melt and as minerals crystallise from the melt, the melt composition changes. Although the absolute composition, it doesn't change. The relative amount changes. And so as crystals come out, they can become enriched in different, the melt becomes enriched with SiO_2 and other minerals because they are not taken out by the crystals that have crystallised.

Speaker 1: Do you feel confident about the order in which these minerals start to crystallise the according to the Bowen's reaction series?

Speaker 2: I think I feel confident about Bowen's reaction series and I know that the order that Bowen's goes in and I could tell you, oh yeah, I know that all of me crystallises first, but I am not too confident in being able to tell you the different minerals of olivine, how you have the different members... do you get my point? It's the different variants of say, Feldspar or which order that they come in that series.

Speaker 1: do you think that there's any concept around traction or crystallisation that you need a better understanding of or is still not clear?

Supplement Magma Pop

Speaker 2: it's mainly that whole order of which variance I think is my biggest weakness. When there was that extra sheet in the lab from last week and it was talking about which would come first, and yeah, I could sort of try and piece things together based on my knowledge of Bowen's, but I was sort of struggling to think about which order they would come in and knowing which specific elements would it prefers. So, whether it prefers calcium or whether it prefers magnesium or which specific elements are preferred in the order of crystallisation.

Sample transcript from evaluation- Post magma pop

Speaker 1. Could you talk to me a little bit about how Magma Pop was helpful in clarifying fractional crystallization or what worked with Magma Pop? Anything that you liked about it?

Speaker 2:

I think I liked that you had to just work with the formula and actually have the repetition of putting the minerals together and that sort of help, I guess with remembering what formula it is. And then also that helps knowing the Bowen's reaction series. It helps to understand the fractional crystallisation, like, these elements going in first and these elements and this mineral. So it's sort of help making the connection, I guess.

Speaker 1:

Okay. Were you able to make the links between the changing composition and were its implications on what kind of eruption would it be?

Speaker 2 :Yeah, we could see that on the right hand corner, that field. It would be nice to have it a bit bigger, to be honest. I did look at it, but then I was like, oh, I've got to do these minerals and now I'm looking at that. So having it somewhere where it's a bit more in view, I guess

Speaker 1:Just wondering, did you try out the tutorial level first?

Speaker 2:Yeah, I had a look at the tutorial.

Speaker 1: Yeah. So in the second tutorial level, you have this part where you can actually zoom in both the concentrations, so maybe we need to do a better job telling that upfront

Speaker 2: Tutorials, no, you could look at the formulas, and you look at what to do. Zoom that and I didn't zoom the window at the right inside.

Speaker 1: Yeah. And any other thoughts on how we can make it better? Anything that caught your eye or you were stuck with at any point?

Speaker: No.

Supplement Magma Pop