Blink, and it's gone

Colin Foster and Fay Baldry discuss different ways in which written mathematics may be shared in the classroom.

Do you remember roller boards? We were recently reflecting on how prevalent they used to be in classrooms when we were school pupils. The teacher would write with chalk on a flexible blackboard attached to the wall and then push it upwards to write more underneath. It would roll around and down the back and, eventually, the previous writing would reappear from the bottom, to be wiped off before the teacher could continue writing more. In a notes-heavy lesson, you might get around this roller board three or more times. And sometimes during the lesson the teacher would roll the board backwards to refer to something they had written earlier. Other classrooms had static boards, but they were large, often taking up most of the front classroom wall.

This all seems to have changed. Now, what we mostly seem to see is a quite small, central whiteboard, possibly electronic, with a projector and sometimes a separate ordinary whiteboard next to it, also often quite small (see Billman *et al*., 2018). Sometimes, *PowerPoint* slides containing examples and questions are projected, so teachers write less mathematics themselves (see Facer, 2019, p. 42; Greiffenhagen, 2014). When discussing these examples and questions, the teacher may end up squashing their writing into the small spaces around the edge, then quickly erasing this so as to advance onto the next *PowerPoint* slide. Nothing is around for long: click and the mathematics appears; blink and it's gone.

Turning to the students, we see some parallels. Although traditional exercise books are still used, the greater use of discussion-based tasks, such as card sorts, and technology means that students may write less mathematics and, when written, it is often in more temporary forms. For example, for large parts of some lessons we see, students could be writing on their own mini-whiteboards (MWBs), and almost immediately, rubbing it off. Often the two technologies work in tandem: a *PowerPoint* presentation on the teacher's board, with perhaps one question presented on each slide, maybe with a timer ticking away on the board, and the students answering on their MWBs. Then the students rub it all off and the teacher clicks to the next question. It becomes a tricky decision for the teacher, in this lockstep approach, how much time to allow for these mini-tasks. It sometimes seems that everyone is either waiting around for others to finish or frustrated at being stopped before they feel they have had a chance. The mathematics is ephemeral: nothing lasts more than a few seconds, then it is wiped or clicked away.

Of course, there are pedagogical and didactical arguments for the benefits of these different types of student participation. For example, card sorts can help to build connections across multiple representations, but, once completed, these are often collected in with no permanent record made. Advocates for MWBs (see for example, McCrea, 2019, pp. 138-139), point to the benefits of the low-stakes nature of the constant wiping: students do not feel the pressure of having to commit their mathematics to the permanency of paper. If they give an incorrect answer, it will be visible for only a few seconds before it is gone forever. This may be reassuring; indeed, perhaps no one except themselves ever sees it. However, might this not inadvertently contribute to the notion that mistakes are terrible things, and that, before writing anything on paper, you must be absolutely sure? Might it not be demotivating to be asked to do lots of work, only to then rub it all out? What is the point of writing a careful explanation, or showing each step of a calculation clearly, if, before anyone has had the chance to look at it properly, it is immediately erased? And what about the errors and misconceptions that go unaddressed because they are never noticed?

Exercise books and roller boards may be old fashioned, and associated with traditional styles of teaching, but they do have the advantage that you can look back, which allows for multiple revisits to complex ideas, rather than expecting students to grasp everything immediately on the first encounter. A student's visual span is not limited to what can be fitted onto one page or screen. When a student is stuck, they can think, "Oh, I did a question a bit like this one a few minutes ago. What did I do then?" or "The teacher helped me with this sort of thing last lesson. What did they do?" and look back at the teacher's annotations on their work. In class discussion, the teacher can say, "This question has some similarities to one we did earlier", and there is the opportunity to compare and contrast. There is a sense of building something up through a lesson or a sequence of lessons.

We were thinking more about this on a recent trip to Japan as part of our ESRC-funded project *Exploring socially distributed professional knowledge for coherent curriculum design*, in which we are collaborating with colleagues at Tokyo Gakugei University. In the school mathematics lessons we saw, we were struck by the careful attention given to boardwork (*bansho*, see Takahashi, 2006). The (chalk) boards are generally long and take up all of the front wall of the classroom. During the lesson, the board work generally develops from left to right: consideration of how the board will look at various points during the lesson is often included in the planning process. Erasing is rare. Consequently, there are many opportunities to look back and make comparisons and review and contrast ideas, and the Japanese teachers seemed to us to be very adept at doing this. There were many times in the lessons when the teachers were talking to the whole class but not writing anything on the board. During periods of discussion and explanation, they were often pointing to things that they had written earlier in the lesson and were making connections with things that had been discussed previously. It left us thinking that having one small board with just one thing on it at a time can be rather limiting, particularly if this is combined with extensive use of pupil MWBs.

We have found it interesting to think about what is visible for students at different points during a lesson. When they are working independently, what will they have immediate access to and what will they be expected to recall? There is, of course, no simple answer to what this should be, but the kinds of technology we are describing seem to take the decision away from the teacher. What is visible to students while they are working will simply be whatever happened to be the last thing that was done. Perhaps all that will be visible will be the questions that they are working on, if these are displayed on the board rather than on paper or in a textbook. In contrast to this, we like the idea of students' own mathematics, and the mathematics collaboratively created in the classroom, being used as more of a resource. For example, if the teacher and students have co-created solutions on the board to several related problems, using several related methods, these might be allowed to remain on the board side by side, and annotations could highlight what is the same and what is different about them.

The act of communicating mathematics through the shared space of boards, and the things that the students and the teacher write, should be valued. If these are considered to be worth keeping and looking back at, then they may be used in discussions and compared with later ideas. This may constitute more relevant use of wall space than the often highly visually-salient permanent classroom displays that we see a lot of in England, and that some claim may be more distracting than helpful (e.g., Enser, 2019, but see also Gates, 2019). A more principled focus on how written mathematics might be shared in the classroom seems helpful.

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Note

1. We choose to use the more neutral term 'electronic whiteboards', rather than 'interactive whiteboards', so as not to imply that having a particular piece of technology in the classroom will necessarily lead to any particular change in 'interactivity'. (At times, the interactivity seems to be more between the teacher and machine, trying to get it to do what they want it to do, than between the teacher and the students or the students and the mathematics.)

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