Learning by Drawing

By Russell Tytler and Peter Hubber

Teachers need to encourage science students to develop their representational skills.

Scientists use a range of visual forms to imagine new relations, test ideas and elaborate knowledge, with digital technologies increasingly used to construct elaborate maps, 3D simulations, graphs or enhanced photographs. These visual tools are not simply passive communication devices but actively shape how we build knowledge in science.

Students in school are exposed to many of these images in textbooks or on the internet. Learning how to interpret them is an important part of science education. However, it is rare that students are encouraged or supported to create their own visual forms to develop and show understanding.

Learning science requires students to develop representational skills by sketching cells observed through a microscope, inventing a way to show a scientific phenomenon like evaporation, or creating a line graph from a table of values.

We propose five distinct justifications why drawing should sit alongside reading, writing and talking as a key element of science education.

1. Drawing to enhance engagement. There is evidence that students are more motivated to learn when they draw to explore, coordinate and justify their understandings compared with conventional, more transmissive teaching.
2. Drawing to learn to represent in science. Constructing visualisations is a key literacy in science, and constructing their own representations can deepen students’ understanding of their conventions and purposes, and help them appreciate how they work to develop explanations and solve problems.

3. Drawing to reason in science. Students must learn to reason in science using several, often visual, modes. Different representations have distinctive attributes that both guide and constrain what learners do and understand. Drawing can require students to be explicit about their thinking and reason by aligning their drawings with observations, measurements and emerging ideas.

4. Drawing as a learning strategy. Drawing can help learners organise their knowledge and integrate new and existing understandings. For example, asking learners to draw an interpretation of a written text requires them to make explicit their understandings. There is evidence that inventing representations helps students to discern the key features and challenges of new tasks and prepare them for future learning.

5. Drawing to communicate. By drawing, students make their thinking explicit. This provides an opportunity for peers to exchange and clarify meanings, and the teacher with a window into student thinking. Drawing can thus serve diagnostic, formative and summative assessment purposes.

At a deeper level, these benefits of drawing relate to the distinctive nature of drawings and visual forms in focusing attention of visual and spatial aspects of the natural world. Drawing offers a particular window into phenomena and constrains students’ attention and choices in coming to understand.

Drawing is an important aspect of an ARC research project run through Deakin University. The project works with teachers to construct lessons around a series of drawing challenges and then discusses the adequacy, form and function of students’ representations and their role in learning. The project focuses on more than visual modes, including everyday and scientific language, embodied forms such as role-play and gesture, and mathematical forms such as tables and graphs.

There is growing evidence that the approach leads to improved learning outcomes, but further research is needed into extending the approach to further digital technologies, and how it can be scaled up to the system level.

___

*Russell Tytler is Professor of Science Education and Dr Peter Hubber is a Senior Lecturer in the School of Education at Deakin University. Professor Tytler is a co-author of “Drawing to learn in science”, which was published in the 26 August 2011 edition of Science.*