Show-how know-how: Part 2

Theory and practice for demonstrating in design and technology

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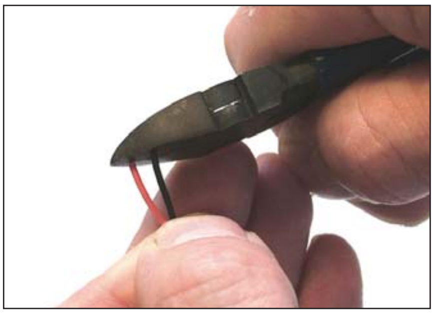
In Part 1…

In the first part of this article (D&T Practice 3.2013) we looked at some of the factors contributing to effective demonstration, as well as further thoughts on the types and planning of demonstrations. In this part, we look at visual and verbal communication, and offer a potential framework for scaffolding demonstrations.

> "First and foremost, the goal of a demonstration is to communicate and model how to do something and how to talk about the task or technology at hand…. The demonstrator must de-mystify the tool or process, explaining what is to be accomplished, what knowledge is applied and the roles of certain skills and senses." (Petrina, 2007: 14)

Visual communication in demonstrations

It is commonly accepted that communication is significantly non-verbal, and for millennia human beings have used symbols, signs and actions to communicate.



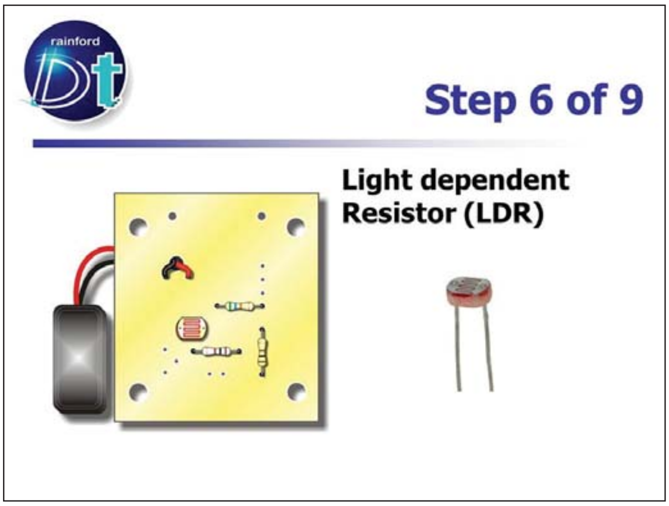
However, you might ask the questions:

- When demonstrating, do the observers (learners) see what you see?
- Does this affect their understanding?

In reality, the visual processing and interpretation in the human brain is sophisticated with the mind constructing and reconstructing what we see into something that we can understand. That being said, individuals perceive and understand in different ways from differing perspectives (physical and cognitive), so the effective demonstrator should consider the important aspects of the activity that the observers need to see. A maxim for effective visual communication might be: make sure that the learners can see what you can see, where at all possible.

There are several ways in which this can be achieved through arranging the learning environment to using technology. Pedagogical choices are determined by the complexity and intricacy of the skills being demonstrated; as well as the novelty/familiarity of the activity to the learners. The simplest approach to overcome this issue of visibility is to gather learners around as close as possible to the demonstration station as practicable. Two factors to consider in opposition to this are, (a) the potential disruption of learners being in close quarters and (b) the configuration/layout of furniture and equipment; although the act of moving from one location to another can underline the transition from one activity to the next.

Access to information and communication technology in many classrooms, in particular the data projector, opens new opportunities for the demonstrator. Many schools have adopted the visualiser as the 21st Century overhead projector, and this device can revolutionise the detailed demonstration of fine motor skills or when working with small objects,



such as sketching and soldering, but there are other alternatives. On the budget end of the scale, modern webcams on flexible goosenecks have enhanced resolution and can be set up to mimic some of the functions of a visualiser. Similarly, more expensive digital video cameras can be connected either to a PC or directly to a data projector. All three solutions present the possibility of pre- or live-recording and playback of demonstrations to enhance the learning experience and reduce the need to re-demonstrate, thus increasing independence of learners and the opportunity for the teacher to circulate and target specific learners for support.

Even without access to and time spent preparing to use video capturing hardware, the data projector can be used to create a slideshow with close up images of critical stages in a process. These can be used both alongside a demo and set up as a 'rolling' electronic poster on a loop that can run during learner activity. The combinations and opportunities are wide and varied, as these resources can be used both inside and outside the confines of the 'classroom' or lesson, hosted on the school website or virtual learning environment.

> "The demonstrator will, of course, demonstrate more than how to perform a task. The demonstrator will also model what he or she knows and the level of skills and safe practice attained. The necessity of a demonstration derives from the inadequacy of words to depict technological processes." (Petrina, 2007: 14)

Verbal communication in demonstrations

With the visual communication taken into consideration, the use of verbal communication can make or break a demonstration. When explaining a process, it is vital the critical stages or steps are identified and presented (explained) effectively (clearly and memorably) using appropriate and technical language. The planning and differentiation of explanations and questioning strategies in demonstrations falls along an expansive-restrictive continuum (Fuller and Unwin, 2003). In other words, the skilful teacher will adapt and modify the balance and depth of modelling, explanation and question strategies to suit the learner. In some circumstances, for example with younger learners or with new concepts, the choice might be to adopt a more restrictive and teacher led approach, with questions being used to gauge recall and understanding.

On the other hand, as learners become more independent or when revisiting concepts taught previously, a more expansive approach might be adopted. For example, questions might be used to prompt learners and probe understanding during the demonstration; even going as far as to present a false statement for learners to react to: "…so we push hard on the lowering handle of the bench drill to force the twist drill into the material…?" [pause for response] or partially prepare personal protective equipment (PPE) and ask "Am I ready to…?" or "What do I need to do next?" As the learners become more skilful, the teacher may chose to use learner demonstrations or narrations, or microteaching[1] (Hattie, 2009: 112-113). These approaches to the scaffolding of learning involve the teacher making decisions to support and facilitate learners as they mentally construct an understanding of the skills being demonstrated.

[1] Peer-to-peer teaching

Scaffolding of demonstrations

Most teachers nowadays are familiar with the taxonomy of learning objectives that has become known as Bloom's Taxonomy. However, fewer are aware that this is just one aspect of learning that the team working under Benjamin Bloom identified. What we know as Bloom's Taxonomy is the cognitive domain, which looked at the logical thinking aspect of learning: knowledge, comprehension, application, analysis, synthesis and evaluation (Bloom et al, 1956). The second area identified the affective domain, which is concerned with the emotions, values, motivation and attitudes: receiving phenomena, responding to phenomena, valuing, organisation and internalising values (Krathwohl, Bloom and Masia, 1956). This too has relevance to design and technology, in terms of the way children learn to interact with and design products, systems and services.

However, it is the third and possibly least well know psychomotor domain that has something important to offer in terms of a theory of practical learning and demonstrations. A number of educators have attempted to define the psychomotor domain, but the one that is presented here was developed by a team of educators from practical subjects working under Elizabeth Simpson (1972). Figure 1 illustrates Simpson's psychomotor domain, with active words that might be used to generate learning outcomes for practical skills, in a similar way to how Bloom's Taxonomy is commonly used. This domain describes levels of proficiency and competence relating to the acquisition of practical skills, and offers insight into how to pitch a demonstration along the expansive-restrictive continuum.

Category	Example	Key Words
Perception (awareness) The ability to use sensory cues to guide motor activity, ranging from sensory stimulation, to responding to cues.	Detecting non-verbal cues. Estimate the amount/size of material required. Adjusts the setting on an oven to correct temperature by smell and taste of food. Adjusts the positioning of a saw on the waste side of a line, allowing for the tool width.	*select, choose, describe, discriminate between, distinguish, identify, isolate, relate to...*
Set Readiness and confidence to act, including mental, physical, and emotional 'sets' (mindsets). These three sets are dispositions that predetermine a person's response to different situations.	Using knowledge to enact a sequence of steps in a designing or manufacturing process. Recognizing personal abilities and limitations. Motivation to learn new processes. This is a responsive stage of psychomotor learning.	*begin to, display, explain, move, act, proceed, react to, show that, state that...*
Guided Response Developing complex skills through imitation and trial and error. An adequate level of performance is achieved through practice.	Performs a focused practical task as demonstrated. Follows written of visual instructions to complete a process. Respond non-verbal signals from an expert (teacher) through direct communication and/or observation.	*copy, mimic, trace, follow, react to, reproduce, respond to...*
Mechanism (basic proficiency) The intermediate stage in learning a complex skill. Actions have become habitual (embodied) and manipulations can be performed with a degree of confidence and competence.	Use a CAD package to design an object to be machined using CAM. Select an appropriate tool (saw, knife, etc.) for a specific task. Use a machine tool or piece of equipment safely under general supervision.	*assemble, adjust, calibrate, construct, disassemble, join, shape, heat, manipulate, measure, repair, replace, combine, organise, sketch...*
Complex Overt Response (Expert) The skillful performance of practical skills involving complex movement patterns. Competent, rapid and precision is indicating highly coordinated performance, expending minimum energy. Performance at this level occurs without hesitation and automatically. Expert practitioners are often confident of the success of an action at this stage, as they intuitively sense that the act will result in a particular outcome.	Using precision tools (such as a jack plane) to produce a high accurate finish. Using CAD software rapidly and accurately to realise concept ideas. Displaying competence using complex and multisensory/input tools and equipment.	*As above, but with adverbs or adjectives to indicate the performance is quicker, better, more accurate, etc...*
Adaptation Skills are highly developed and the individual can modify movement patterns to fit specific and novel requirements.	Responds effectively to unexpected experiences. Modifies instruction to meet the needs of the learners. Perform a task with a machine that it was not originally intended to do (machine is not damaged and there is no danger in performing the new task).	*adapt, alter, change, rearrange, reorganise, revise, vary...*
Origination Creatively producing new movement patterns or combinations of practical skills to fit a specific contexts or problems. Learning outcomes emphasize creativity based upon highly developed skills.	Creates new concepts, approaches or practice by combining or adapting existing knowledge. Develops a novel and comprehensive processes and routines to manufacture a complex product more efficiently.	*arranges, build, combine, compose, construct, create, designs, initiate, make, manufacture, originate...*

Figure 1: Simpson's psychomotor domain (adapted from www.nwlink.com)

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Further reading

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