

# Putting Imagery Back into Learning: The Case of Drawings in Human Physiology

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Visual imagery is widely recognised as an important mode of cognition. Kosslyn and others (e.g. Kosslyn and Koenig, 1992) have shown a close relationship between visual imagery and visual perception, which leads to our ability to manipulate and interpret mental images in new ways. Working with images is greatly

facilitated by the human ability to draw using an external medium.

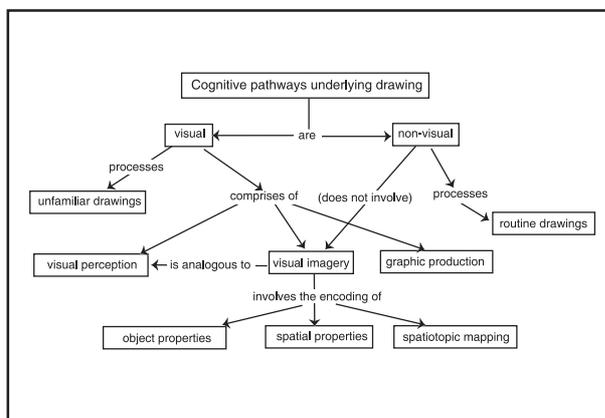
Children's drawing has been seen as an indicator of development (e.g. Piaget and Inhelder, 1967). Karmiloff-Smith (1995) in re-looking at cognitive de-

velopment, argued for system-specific constraints in the notational domain (in which she included both drawing and writing). Drawings have been viewed as a medium for social and cultural transaction (research inspired by Vygotsky: Brooks, 2002), learning and thinking (Arnheim, 1974) and as a tool for problem-solving (Ramadas and Shayer, 1993). The relationship between drawings and visual imagery has however been little explored. In general, research on drawings has focused on early spontaneous productions while that on imagery has dealt with simple, easily coded depictions.

The practice as well as pedagogy of the image-rich field of science depends critically on the use of drawings. Drawings in science are embedded within an elaborate conceptual context. Children's use of drawings in science therefore, must be seen in relation to their visual imagery as well as to their propositional understanding in the content area. Here we employ Paivio's dual-coding hypothesis relating to two separate but highly interconnected components or coding systems of cognition, namely, imaginal and verbal. While the verbal system processes linguistic materials, the non-verbal system (a major aspect of which is visual imagery) is specialised for the processing of non-verbal data (Paivio, 1980).

To understand the role of imagery in drawing, we used the model of van Sommers as modified by Guérin et al. (1999). The model posits two kinds of cognitive pathways in the production of drawings: a visual pathway for the processing of novel and unfamiliar drawings, and a non-visual pathway for the processing of routine, familiar drawings. We submit that the current pedagogy of science bypasses the visual imagery pathway, leading to routine processing of drawing. Some evidence is discussed and remedies suggested.

**Fig. 1** A schematic representation of the model of Guérin et al. (1999)



## Methodology

Twelve mixed-ability students from classes 6, 7 and 8 of an English medium school in Mumbai, India were asked to respond to four questionnaires pertaining to the structure and functioning of the human body, specifically the systems: digestive, respiratory, circulatory, nervous and excretory. The questions conformed to the content of the textbooks used in their school. Students were provided with outlines of the human body, within which they could draw the systems. The questionnaire required the students to perform three tasks:

- ♦ Draw the organs of a particular system of the body using plain lead pencils along with colour pencils or crayons.
- ♦ Visualise the process of digestion, respiration, circulation, etc. by forming a visual mental image of it, for example, of eating a favourite food, tracing the path of a drop of blood through the body, tracing the path of a nerve impulse on touching a hot object, etc. They were asked to depict these processes through drawings and words. This question probed their understanding of function and their spontaneous use of drawings.
- ♦ Describe the images they visualized when thinking about a given structure or process. Analogy was used as a tool to enable the subjects to generate visual images.

The questionnaire was followed by clinical interviews. The subjects were asked about their preferred mode of communication- either drawings or written expression. They were also asked if drawings could replace written content in textbooks.

## Analysis

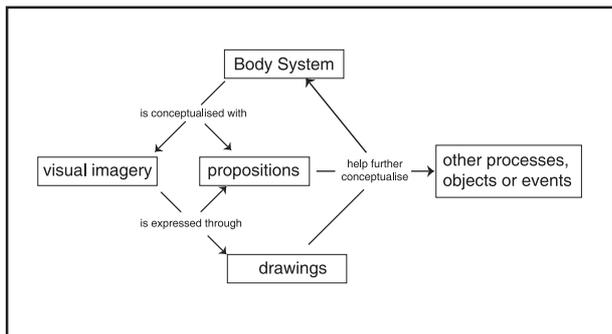
The analysis included:

- ♦ A classification of the generated visual images.
- ♦ A classification of drawings depicting body systems.
- ♦ Case studies of a few students to illustrate usage of visual imagery and pictorial notation.

## Findings and conclusions

Students' drawings largely conformed to those in their textbooks. Questions about processes however, spontaneously, elicited flow-charts, a list of organs or a list of concepts connected by arrows. We argue that their drawings and descriptions, both written and spoken, suggest the use of a primarily non-visual pathway. Ideally, if the visual imagery pathway could be activated, it would enable drawings to be used as a tool for thought as shown in Fig. 2.

**Fig. 2** Role of imagery and drawing in the conceptualisation of any specific content area



Subjects were equally divided in their stated preference for diagrammatic or written expression. However, their written responses indicate that they were more at ease with propositional descriptions and less comfortable with using drawings. Some common alternative conceptions about the working of the human body were also identified

Forming a visual image and manipulating its components enhances learning and problem-solving. In this study, we used analogical thinking as a data gathering tool, but found that it served a pedagogical function also, by facilitating visualisation. We propose that in the case of human physiology, visual imagery is a mediator for drawings to function as a tool for thinking and learning.

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