OBSERVATION AND DRAWING IN LEARNING SCIENCE

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ABSTRACT

Drawing pictures, and realising one's capabilities in drawing are effective means towards self-empowerment. Being able to draw, as a means of communication and self-expression, is in this sense similar to being able to read and write. In as much as it increases one's ability to observe, understand, compare, analyse, communicate, and be creative, drawing can also increase one's scientific literacy. A few ideas on how student drawing can be used (and misused) in science teaching will be discussed.

I will also discuss ways in which graphic arts (including drawings of objects and places, photography and video, as well as graphs, diagrams, designs, plans, and all kinds of graphic organisers) can be used and misused in science teaching materials. In particular I will discuss examples from science textbooks of the use of art to increase enjoyment, to identify organisms and objects, explain mechanisms and processes, and to communicate social and political points of view.

INTRODUCTION

What are the uses of art in science teaching and learning? How can art be used in positive ways? And how is art often misused in science teaching?

I will discuss these questions, and give examples of the way art is and can be used in teaching science.

ART FOR ENJOYMENT, APPRECIATION, AND WIDENING PERSPECTIVES

One obvious use of art in science teaching is simply to add beauty to science textbooks, worksheets, charts, and other educational aids. Art is used as decoration, and to make the material more interesting and enjoyable for students. This is certainly a worthwhile aim. For example, visual art in the form of drawings, paintings, and photographs can encourage students to appreciate nature.

However, it is not possible for art to be **just** a pretty picture. Art always communicates a lot more than just beauty. Moreover, there is no one picture that everyone will find beautiful or that will succeed in interesting every student. It may not even be best to try to please the majority – perhaps the majority should also be exposed to unusual forms and examples of art. Illustration in science can also widen cultural perspectives and aesthetic sensibilities. This kind of multiple underlying meanings, uses, and misuses of art in science will be further discussed below.

Students' interest in science can also be enhanced if they draw pictures as part of learning science. When they are drawing they are necessarily more involved than when they are just listening and/or looking. Drawing is an important part of an activity-based science classroom. Art is an enjoyable mode of self-expression and communication, as well as a skill useful in science and other areas. So why not consider drawing to be just as essential as reading, writing and arithmetic?

DRAWING TO ENHANCE OBSERVATION

When students draw pictures of things they see, it enhances their observation of these things. This can be demonstrated by looking at an object, say a potted plant that is sitting in front of you. If you look closely at the plant, and try to draw what you see, as you see it, you will find that the act of drawing forces you to make many observations, comparisons, and analyses that you would not make if you were simply looking without drawing. You may notice that the leaves are more rounded at the bottom, that some leaves have sharp points curving downwards, while others don't, that every leaf has another leaf on the opposite side of the stem, etc.

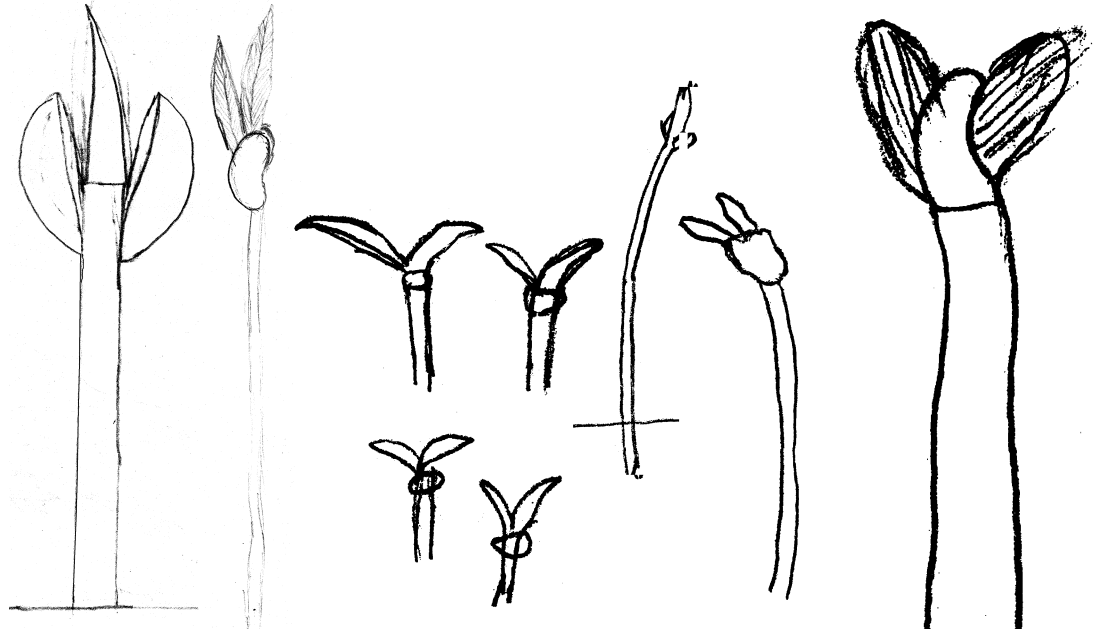
In order to use drawing as a tool to enhance observation, it is important for students to look at actual objects that they can clearly see in front of them while they are drawing. They will learn much more than if they are just asked to copy a picture from the board or from a book. Of course the teacher could simply tell the class that the leaves on a certain plant have opposite leaves, and ask them to copy a picture of opposite leaves that she has drawn on the board. But the lesson will be much more meaningful if the students themselves discover that the leaves are opposite while they are in the process of drawing.

Consider a case where, for example, students are asked to draw pictures of green vegetables. Rather than drawing from memory, it would be much more meaningful if students have an assortment of green (and non-green) vegetables in front of them so that they can observe and draw what they see. In addition to demonstrating that they can remember that spinach, methi, cabbage, and chilli are green vegetables, they can also learn new things about the shapes, sizes, variations in colour and texture of these vegetables if they can observe while drawing.

Teachers should not be afraid that the students will not be able to draw objects they see. The youngest students are always eager to take up a crayon and try to see what they can do with it. It is only after having been exposed to some "education" that some students start saying, "I can't draw." In my own experience, I have found that even those who are the most stubborn in this belief **can** draw good pictures. The only rule I follow in encouraging them to overcome their fear is that I never draw for them, or even make any mark on their paper. I simply tell them that I know they **can** draw. I ask the student to look at the object and tell me what they see. After some time, they might say that they see a branch. "And what shape is the branch? Is it straight, or does it curve to the left or to the right?" I ask as I stand next to them, pointing and trying to see what they might see. "It curves this way," the student might say. "So make a line on your paper that curves that way," I say. After a few minutes, and with some positive feedback, and plenty of reminders to "Keep looking!" the student will be intently drawing away. It may also help to take away a very hesitant student's eraser, so that the picture is not erased before you see it. I also find it easier to let the students draw in pencil or pen, without colouring, since details usually appear more clear in black and white.

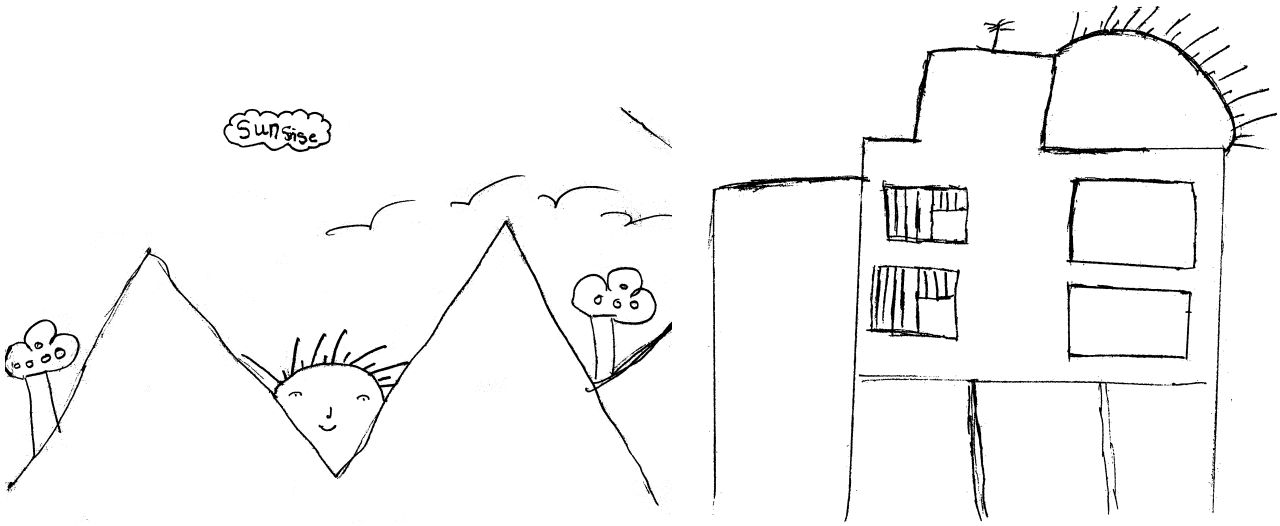
If the teacher has a preconceived idea about what the students' pictures should look like, then the teacher may be disappointed, and the students may in turn become disillusioned

about their abilities to draw. But if the teacher has faith in the children and expects them to see and draw things in their own ways, no one will be disappointed. The children will come up with drawings that will each be amazing and wonderful in their own ways, as shown below:



Drawing while observing encourages each student to see things in their own way. When five different students draw a sprouted seed that is placed between them, they will draw five entirely different pictures – one may show tiny root hairs that were visible from one side, one may have noticed that the seed cover was cracked asymmetrically, and another my have drawn how pointed the root was at the tip. They can learn from each other. And at the same time they can also learn that there is not just one way of looking at something and that there is not just one correct answer in science.

It is usually easy to assess whether a student has drawn what they have observed or not. The picture on the left is a case where a student obviously did not go out to draw a sunset as they saw it. In contrast, clearly, the picture on the right was drawn while looking at a sunset.



USING ART TO RECORD OBSERVATIONS AND TO IDENTIFY ORGANISMS AND OBJECTS

Pictures can be more informative and useful than words.

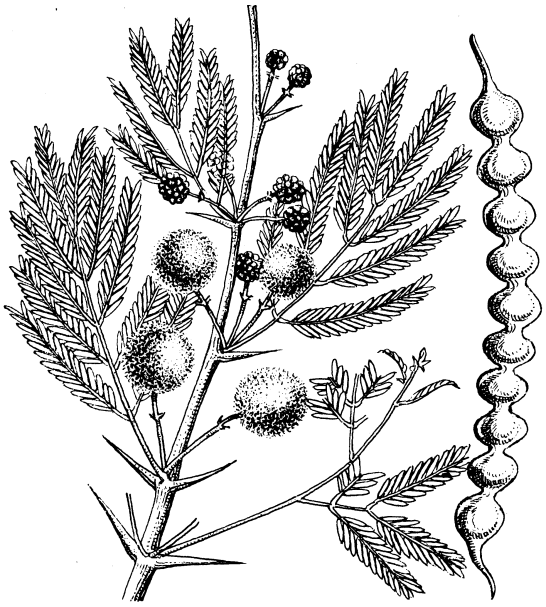
For example, consider this description of leaves from the Kadam tree: "Leaves up to 25 cm or more across, broadly oval or circular in shape, acute at the apex, heart-shaped at the base, slightly hairy especially when young, green or tinged with red or pink; nerves: a strong one running from the base to the tip of the leaf and 5-6 pairs of lateral ones, which unite in a wavy line near the margin of the leaf. Leaves come out in pairs, one on either side of a branch, their stalks connected by a pair of stipules. There are two leaf-like structures, up to 2.5 cm ling, enclosing and protecting the very young leaves and shoot apex; when the stipules fall away, they leave two clear lines, each encircling half of the branch. Leaf stalks are 5-10 cm long."

The text is informative, but even for someone familiar with all the terminology, it is much simpler to get an idea of the leaves by a glance at the drawing.

For another example of how pictures can be used to record observations, consider the following sequence that shows how a banana peel rots:

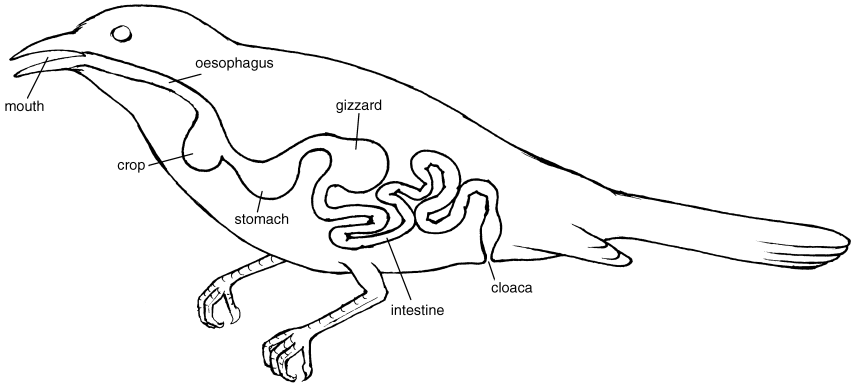
Students can make discoveries by observing (and drawing) pictures like these (What is different? Guess why. What else do you see in the picture? How many animals do you see? What is the snail doing?).

Notice that the type and style of each picture is important, and different kinds of pictures are suitable for different purposes. In the case of the banana peel, the above black and white line drawings are probably more informative than the usual quality of colour photographs would have been. Similarly the following illustration of babul from an old book is more useful than the colour photograph on its right of a common food plant from a modern CD encyclopaedia. The colour photographs are probably used because the publishing company is more concerned about attracting buyers with colour pictures than with being useful. Or perhaps they would have to pay more for a drawing than for a photograph? Is this another example of how science suffers when science is profit-motivated?

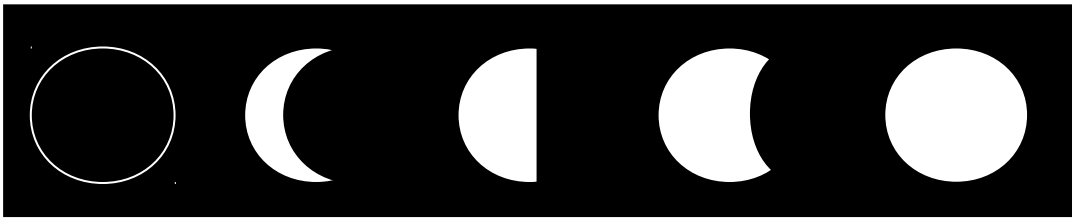


USING ART TO EXPLAIN MECHANISMS AND PROCESSES

Various forms of graphics can be used to explain events, functions, and structures in many different fields of science. This includes all kinds of diagrams, sections, graphs, and various graphic organizers like Venn diagrams, flowcharts, etc. Pictures can be used to simplify and generalise complex structures and processes, for example in this diagram of a bird's digestive system.



Pictures (even photographs) in science textbooks can also be misleading. There is often a communication gap between writers and illustrators, and illustrators often do not take the time to observe and/or do adequate research before drawing. To be fair, the publishers are often the ones at fault, expecting illustrations to be quickly done and pasted on to a manuscript just before a deadline. For example, consider the following illustration of the moon phases that is found in many Indian science textbooks. It seems the illustrator did not look at the moon.



COPYING PICTURES AS A MEMORY TOOL

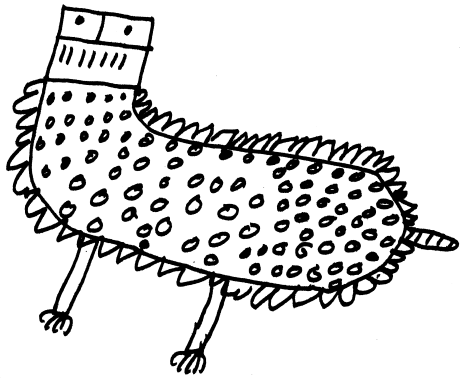
Students are often asked to copy pictures and diagrams, memorise them, and then reproduce them for examinations. While at times this may be useful, it is often overused and misused as a method of learning. It would be more meaningful if students went beyond memory, to do something that is more interesting and involves higher levels of critical thinking. It is possible to memorise and reproduce a diagram without even understanding much of what the diagram represents.

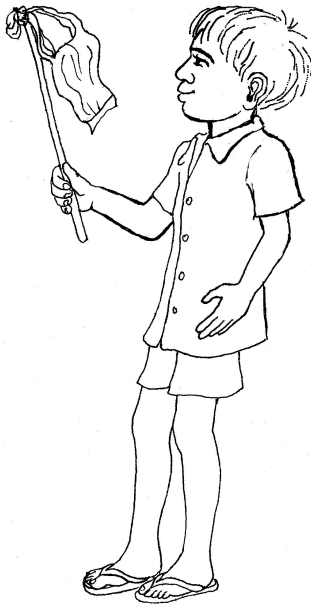
USING ART FOR EMPOWERMENT AND TO COMMUNICATE SOCIAL AND POLITICAL POINTS OF VIEW

One of the main blockages to learning and achieving is a student's lack of faith in their own ability. Particularly when dealing with the underprivileged, teachers must address problems of the 'psychology of the oppressed'. Such students feel that science is something foreign, which is done by people that are not like themselves. Students find relatively few pictures of girls in their science textbooks, and they therefore get the impression that science is mainly for and about boys and men. In fact, it is very difficult to find a science textbook in India that does not have a far greater number of pictures of males than females. Furthermore, males are more often shown in active roles, while females are in the background, just looking on.

The people shown in Indian science textbooks usually appear to be quite European looking, almost never having even moderately dark skin. An Indian girl has nothing to identify with. Imagine the difference if she could see a picture of someone who looks like herself, actively engaged in doing a science experiment –it would make her feel more important and self-confident.

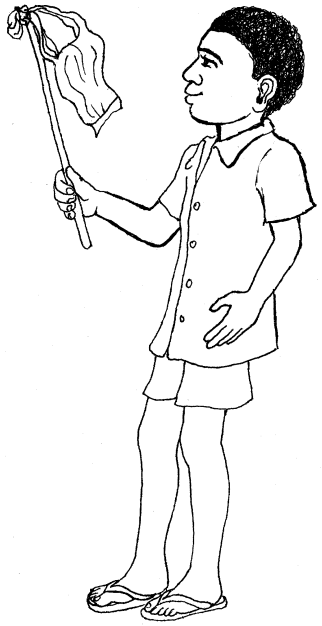
Even the style of the illustrations is important in this regard. Imagine the empowering effect if the usual western style of illustrations in a science textbook is accompanied by pictures like the one on the right. The children who draw like this themselves would feel a sense of 'ownership' of their science book.





Pictures, even those that are used for teaching and learning science, always have a point of view. For example, consider the picture on the left, that could be used in a science textbook to show a student experimenting with the way air blows a plastic bag that is tied to a stick. Many people look at this picture and see a cute little boy.

But when the same people look at the picture on the right, , they do not think the boy is so cute. The only difference is in the hair, which makes the first boy look more Caucasian. People have been conditioned to think that children are cuter when they have blond hair. The science textbook will be different, depending on which of these two pictures is used. With the second picture, some people may think the book is not as attractive. But it also may counter the prevailing predominance of Caucasions, and help some children identify with pictures of children who look more like themselves. Using the second picture in a science textbook will have different implications. Implications are inevitable – it is not possible to design a socially neutral book. However it is possible to be aware of one's point of view and analyse the possible outcomes of alternative designs.



When students observe and draw what they see as part of their science learning they also find out that they can do something that they may have thought they could not do. They become empowered. In my own teaching whenever I have taken a student's picture, pointed out a few of its interesting characteristics, and posted it on the board, I have found that the drawer beams with pride. Any lingering feelings of inferiority get washed away.

Of course, the teacher should take care to avoid making sweeping value judgements in comparing of the pictures of different students. It is better to discuss differences between the pictures with the point of view that everyone does and should draw differently, pointing out how each picture has it's own beauty. Thus, students will learn that they can communicate and express themselves through art, and they will also learn to appreciate aspects of each other's art.

In conclusion, I would like to stress the importance of art in teaching and learning science. The use of art is in doing art as well as in seeing art. By doing art, students can be create and communicate new ideas. By seeing art, students can be inspired by new directions and new ideas.