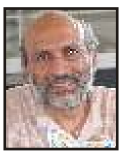
WITHIN THE CLASSROOM

Making Things, Doing Things

Arvind Gupta



Good science need not be expensive. It can also be great fun.

The best Indian book on primary science, Preparation for Science, dates back to 1928. It was written by Richard Greggs - an American economist who was deeply inspired by Mahatma Gandhi. For two years Greggs taught activity-based science in a school in Himachal Pradesh run by the American missionary, S. E. Stokes. This remains the most pioneering treatise on how science should be taught to children in Indian schools.

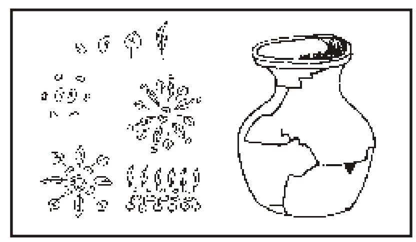
Greggs wrote:

"The apparatus required is exceedingly simple and inexpensive, and almost all of it is familiar to village children. Most of it can be made by village carpenters, potters or blacksmiths. The children must not get an idea that science is machinery or strange technology. The great pioneers of science did their work with very simple apparatus. It is possible, therefore, to follow their footsteps and learn to do scientific thinking without much expensive or elaborate apparatus. After all, the student's mind is the most expensive piece of apparatus involved."

Greggs further commented, "I do not want Indian children in villages to get the idea that science is only a school affair or only relates to shiny brass and glass devices and paraphernalia. I believe they can learn to think more clearly and to acquire a scientific attitude without all the expensive and complicated apparatus used in western laboratories, or at least with extremely little of it."

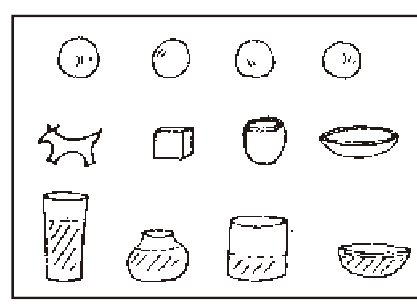
As has often happened in the history of science, this prophetic book remained buried until Keith Warren, a UNICEF consultant, rediscovered it in 1975, illustrated parts of it, and brought it out as 'Preparation for Understanding'. It helps children to discover an order in the world around them. They seek out patterns using pebbles, twigs, leaves, wire, seeds and other natural materials - stuff which does not cost much at all. If children don't have paper / pencil, they draw patterns on the ground with a stick.

Children arrange leaves and seeds to make several *"rangoli"* like patterns.



Children are asked to piece together a broken earthen pot with wet clay, akin to solving a 3-D jigsaw-puzzle.

In another exercise, a child takes four similar balls of clay. S/he then moulds each into a different shaped animal, a cube, a pot and a plate. The child is then asked: Which one is heavier? Does the shape change the weight?



Children pour out the same cupful of water in four different containers. Then they are asked, "Which vessel contains more water?"

The basic tenet of the book is : Before children can understand a thing, they need experience: seeing, touching, hearing, tasting, smelling, choosing, arranging, putting things together and taking things apart. Children need to experiment with real things.

The best Indian effort to revitalize school science education was certainly the Hoshangabad Science Teaching Programme (HSTP). Started in 1972, the HSTP eventually spread to over 1000 government middle schools in 14 districts of Madhya Pradesh. It was based on the discovery method - children performed simple experiments and then answered questions based on what they did. They were not "passive consumers" but "real constructors" of knowledge. There were no text-books, only workbooks. The programme involved the active participation of teachers in designing the curriculum. It attracted many passionate and competent people. Prof. Yashpal came as the first teacher trainer. It unleashed tremendous energy and creativity. The task was not just to replace standard flasks with local glass bottles. The search was for local substitutes, low-cost, non-alienating materials, close to the cultural milieu of the child. This required an open mind and a critical outlook. Children dispensed "dissecting needles" in favour of "babool" thorns. Phenolphthalein - an indicator used for titration - was discovered in the well known brand of laxative "Vaculax". The tablet was mixed in a known quantity of water to make a wonderful "indicator".

The Second World War devastated many nations. Faced with severe economic hardships, some poor countries managed to build schools. But then they had little money left for setting up science laboratories, which were expensive to build. In the late 1950s, J. P. Stephenson, a British teacher, put together a book showing possibilities of doing process-based science using very simple materials. The title of the book was itself significant: Suggestions for Science Teachers in Devastated Countries. This book took the world by storm. It showed that expensive, fancy equipment were far removed from the lives of ordinary children - in fact very alienating. UNESCO agreed to widen and deepen the scope of the book and thus came out the famous UNESCO Source Book for Science Teaching, the Bible for science activities. In 1963, this book was translated into Hindi, Marathi and a few other regional languages.

The UNESCO Source Book for Science in the Primary School, authored by Winnie Harlen and Jos Elstgeest, was first published in the early 1990s. Its international edition was priced at US $20. Fortunately, the National Book Trust reprinted a low-cost Indian edition of this wonderful book priced at just Rs 65. This book has never been reviewed but it is still in the fourth reprint. This reposes my faith in ordinary teachers - a good book, reasonably priced, will sell well. The book has two parts: a theoretical section followed by four amazing science activity sections - Children and Water, Children and Balances, Children, Mirrors & Reflections and Children and the Environment. If only some visionaries would translate these activity books into local languages?

Experience the world over has shown that pre-packaged science kits seldom work. In most cases they lie unopened. The teacher did not think of them, design them, assemble them and so s(he) is not confident to use them. The kit could break when used. So it is best kept locked up. But whenever teachers have been shown possibilities of making simple science models using everyday materials they have shown great enthusiasm. When they make things with their own hands they feel "empowered" and are more likely to use them in practice.

We live in a consumerist society which produces mountains of junk - cardboard cartons, ball pen refills, old pens, coins, broomsticks, newspapers, cycle tubes, matchboxes, tetrapaks, milk bags, ice-cream sticks, straws, etc. The list is endless. All this stuff can be recycled back into joyous science models and toys for children. For instance, primary school children could make a wonderful hand pump with two film cans joined by a length of old cycle tube with flaps of sticky tape for "valves". This inexpensive pump can inflate a balloon and throw water 10 feet away!

Children understand best when they see a science principle incorporated in a toy. If they can play with it, then they get a better "feel" for it. "Centrifugal" and "centripetal" forces are abstract words and mean little to children. But a broomstick "spinner" can lend meaning to these words. A self-made toy acrobat which flays its hands and legs when spun can concretize this concept. A hundred such wonderful science toys have been collated in a book titled, The Joy of Making Indian Toys, by Sudarshan Khanna (published by the NBT and costing Rs. 40 only). These toys have been there since ages. Every generation has enlarged this repertoire and left them behind in the public domain. These toys, made from 'throw away' stuff, are eco-friendly and the poorest children can enjoy them. In sculpting them, children learn to cut, trim, glue, fix, nail and assemble together a variety of materials. They also learn great science.

The crisis of science is that people still do not want to dirty their hands. Rote learning, the chalk-and-talk method still reigns supreme. Everyone is out to "cover" the course, forgetting that the whole task of education is to "uncover" things.

Ann Sayre Wiseman, creative director of the Children's Museum in Boston and the author of the landmark book, 'Making Things', summed up the essence of good science in these words:

It's OK to fail.

It's OK to make mistakes.
You will learn a lot from them.

It's OK to take risks.
It's OK to take your time.

It's OK to find your own pace.
It's OK to try it your own way.

It's Ok to fail.
You can always try again free of fear.

It's OK to look foolish.
It's OK to be different.

It's OK to wait until you are ready.
It's OK to experiment (in safety).

It's OK to question the "shoulds".
It's special to be you.

It is necessary to make a mess
Which you are willing to clean up.
(The act of creation is often messy)

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Listening to Children's Voices in the Science Classroom

Jyotsna Vijapurkar

A large body of research in science education has demonstrated that children have alternative concepts quite different from what is taught in the science class. Most often, the exercise of teaching changes children's ideas from one incorrect concept to a modified, but still incorrect one. The good news is that teaching does help bring about a concept change; the bad news is that often it is not quite what the teacher had in mind!

The very fact that researchers have uncovered so many alternative concepts that children hold, despite instruction, indicates that someone, somewhere was listening to what children had to say. Surely a clue of this kind would have had to be the starting point, the motivation, for further investigations.

Time and again, however, while working with teachers, it has emerged that a lot of children's ideas and theories come as a complete surprise to them. I have been struck by how large a number of teachers seem unaware of what is going on in the child's mind. Why is it that even after teaching for years, the realization that there is a disconnect between what is taught and what is learned continues to elude us?

The answer, I am convinced, lies in how our science classes are conducted.

In a typical classroom, when the teacher poses a question, one or two hands go up, one child gives the