Little Science

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Some children appeared very excited about the little science experiment they had done yesterday. They were animatedly discussing their findings though the science class was yet to begin. In the chapter titled 'Diversity in Nature' they were asked to find two exactly similar leaves. It sounded trivial as not to be worth trying. Wasn't it obvious that two leaves from the same tree would have the same shape? Aren't all *peepul* leaves heart shaped? But the problem entailed finding 'two exactly similar leaves'. Maybe, two leaves on the same twig might not exactly be the same size or shape but then weren't there thousands of branches with millions of shimmering leaves on the *peepul* tree. Then there were so many *peepul* trees in the village. Certainly, it won't be an impossible task to find to exactly similar leaves. Thus went the line of reasoning as these village middle school children - part of the *Hoshangabad Science Teaching Programme* (HSTP) continued their search. The problem bugged and boggled them even after the science class. While clambering back home they were still intently looking at loaves, to find an exactly matching pair.

The next day a girl did turn up with two similar leaves of the lowly lantana shrub. They looked 'almost alike'. But were they exactly alike? Even if the leaves could be superimposed on one another, did they have a similar vein pattern? This prodded the children to probe from the macro to the micro. Some of the children improvised a microscope by gently placing a water drop on a glass slide. Then they peered through its plano-convex lens to compare the vein structures of the two leaves. In the meanwhile some other children improved upon this rudimentary microscope to make things appear more clear and magnified.

The apparently simple problem of finding two exactly similar leaves had brought the children very close to appreciating the variety and diversity in nature's marvelous kitty. Their own search led them to the realization that it's difficult to find two exactly similar leaves in the natural world. Is this diversity something specific and confined to leaves alone or does it extends to other natural forms too? For instance, is it possible to find a pair of exactly similar stones or human forms? Hopefully, the children would still be mulling and wondering over these questions.

This experiment is part of the *Hoshangabad Science Teaching Programme* (HSTP) where some 40,000 middle school children in 13 districts of Madhya Pradesh are learning science by the discovery approach. There are co drab and boring science lectures, but instead, children learn science by actually doing experiments in groups of four. The improvised kit consists of a lot of daily life objects like plastic glasses, cycle valve tube, matchboxes, old injection bottles, buttons, *babool* thorns etc. One great advantage of learning science by using local materials is that children learn that science is a daily life affair. That science is part of the daily phenomenon of living and not something esoteric which has to be mugged up and spitted out exclusively for the purpose of passing exams.

Apparatus for the few or the many

Given the very high drop out rate in schools if 99% of the children are not going to be academic scientists it might be expected that only 1% of the apparatus used in school science would be of the standard conventional type, supplied by some commercial manufacturer. Surprisingly, the opposite seems to be more nearly the case. Most of the village schools are starkly bare, bereft of any worthwhile infrastructure or facilities to engage children creatively. On the contrary, the urban schools are often saddled with a lot of useless or unusable hi-tech junk. How many schools, for instance, possessing slide/film projectors, use them optimally? The impact of such a grossly; undemocratic policy is that the majority of our children are starved of relevant practical, scientific experience.

It is better for children to make simple things/projects/apparatus with their own hands. It's a sound policy because a child's learning proceeds from the concrete to the abstract. A rich and varied experiential base gives the children an excellent foundation for building up abstract conceptions. Children, up to the middle school level can do a whole range of simple science experiments using very inexpensive locally available material, for the initiated, the environment itself provides an eternal laboratory.

Of course, children cannot be expected to make torch bulbs, batteries, magnets, reasonably accurate weighing devices, or plastic centi-cubes (1-cm edge length cubes) and several other standard items. They have to be bought and supplied to the schools. For making their own Improvised experiments and apparatus, the children require apart from a resourceful and encouraging teacher, certain basic minimum infrastructural facilities. These are sorely lacking in most of our village schools. Most schools do not even have *tat pattis* (jute mats) for the children to sit on. Often children carry their own cement jute bags for squatting. More than 90% of the primary school budget goes into the teacher's salary. Hardly 1% of the budget is available for teaching aids - the bureaucratic definition of which seldom extends beyond a wall map of India and a few gaudy photographs of national leaders.

On the other hand the cost of most commercially manufactured teaching aids and equipment is prohibitive. The only company licensed to make the entire Montessori kit (Kaybee School Equipment Corp, Hyderabad) sells the kit, appropriate for 30 children, for a whopping Rs.50, 000/-, This is too high a price tag for even the very elite Indian schools. So, this company exports most of its hand crafted Montessori teaching aide to the U.S.A. But, apart from the expense, is the Montessori kit designed over 60 years ago appropriate for today's schools? Maybe a few items of the Montessori kit are still relevant, and should be retained. For instance, most of the inset puzzles — matching the right block in the right slot - which is part of the Montessori kit, can be produced at one tenth of their price by punching them out of shoe sole rubber sheets, instead of cutting them with a fret saw using precious teak wood. Rubber sole insets, apart from being pliable and flexible also have a snug fit. They are amenable to mass production at the cottage industry level using simple appropriate technology. Unlike wooden insets, the insets in rubber have no shrapnel's and are thus very suitable for handicapped and blind children.

The use of toys, and domestic objects

Something's with which children have always played and learnt a lot, but which are seldom used by teachers to illustrate scientific principles. In a remarkable book titled 'Dynamic Folk Toys' Sudershan Khanna -a designer at the National Institute of Design, Ahmedabad, has collated a number of folk toys which lucidly demonstrate simple principles of science like motion, gravity, sound, elements of machines etc. There toys have been made for generations by local craftsman using scrap and discarded materials. Today folk toys are dying out because of the publicity blitz and aggressive sales of mass produced toy manufacturers. As folk toys are a product of a people's culture, they are low cost and non-alienating and can be used very effectively for elucidating a number of science principles.

We should avoid special manufacture of any object if it is possible to substitute it with something within the local milieu. Indeed it may be an educational advantage to use an object which the children recognize rather than a foreign looking object remote from their experience.

Press Button Switch

During the recent HSTP camp at Bhopal a resource person came up with a brilliant idea. The HSTP has a chapter on electricity where the children learn to make various circuits by connecting torch bulbs and batteries in series and parallel. Since the last 15 years in HSIP a search is on for an appropriate on/off electrical switch — several versions and variations have been suggested and tried out. For instance, the simplest switch would be to twist two copper wires together, short circuiting them in the process. But, kinky wires are messy business. A steel strip bent into a Z shape and nailed to a wooden board is another alternative switch. The trouble with the steel blue strip is that it rusts making a bad contact with high junction resistance. In a flash of brilliance, Vivek Paraskar, a resource person from Ujjain, discovered that the two pieces of ordinary Press Button (snap button) makes an excellent low-cost electrical switch. Moreover, because these press buttons are made of brass, they never rust and have an almost negligible contact resistance. Since then the teachers have found several alternative uses of press buttons.

Sometimes toys may be more useful pedagogically, culturally and mechanically for helping children in understanding science than specifically manufactured educational apparatus. For example, the earlier, NCERT primary science kit contained a large plastic wind direction indicator. It was expensive, and occupied a lot of space in a small cabinet. Moreover, it pointed upwind which confused the children. In fact, it is unnecessary to have a specially constructed wind vane In India since children here commonly fly flags and kites, all of which indicate wind direction. Moreover, before launching a kite a young boy usually throws up some dust to see which way it drifts. From this he gets not only an indication of the wind but an estimation of the wind speed as well.

Science for all

We must stop aping the west and look critically at our own resources and possibilities. It is possible to implement an activity based science programme for all our children. The resources required for it would be a pittance indeed, when compared to 55 paisa per day per citizen that we spend on defense. What's lacking is not funds and human resources, but the political will.

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