

## **SCIENCE EDUCATION – GENERAL PHILOSOPHY**

The Science System is built on making use of observation and experience. Further, observation and experience cannot be given by stating facts in a book – not even by a limited number of experiments carried out in the "lab" (relevance will be lost). Also, the quality and quantity of experience is widely varying for different age groups and different sections of society. Even the basic skills of visualization and thinking are poorly developed in some. It is necessary, therefore, that Science should be taught only on a common minimum base of experience which itself can be imparted by teaching and practicing skills in doing things (including games). There is a particular rate at which new information can be learnt (absorbed) and retained. The teaching of Science as an adjunct to teaching of skills will help ensure that more Science is absorbed, retained and utilised. Science will also be seen as relevant to life when it is taught with reference to the experience that every one has acquired earlier. Education / Science should build confidence to make each student self reliant and better equipped to face challenges of life.

The enclosed note on "Way Skills Development as a Base for Education?" will give more Idea on the importance of skills development as a carrier for Science education; also -the nature of skills will be brought out.

### **1. WHY SKILLS DEVELOPMENT AS A BASE FOR EDUCATION?**

"Small is importance" - For want of a Nail, the horseshoe was lost.... and so onto the loss of the Kingdom. In every day life, we have to do so many little things. Generally those who are successful in life are the ones who can get a large number of little things done better than others. Even big things, say setting up a new factory, is made up of little things, like laying of bricks neatly, the machines to be laid out thoughtfully and. all electrical joints made properly. Why, do some people do these little things better than others? In my opinion, the two important parameters are skills and pride. One must have the skill, the talent to do that and one must have the pride in of that work. Even an Intelligent person is not born with all the skills - his rate of learning will be faster but he has to learn it and. develop it. The exceptions may learn by themselves by good observation and adoption. In general one has to be taught these skills. The pride comes from a realization that what one is doing is important and doing it better will earn appreciation.

So if we want the big projects to be successful our masses, from the lowest unskilled job to the highest skilled experts must do little things ever better. This is possible only if from their childhood we give them a variety of skills and develop the pride in doing these little jobs better.

Very often the pride comes when a certain skill is acquired. The child who learns to read., likes to show off the new skill.

If we teach skills and give importance to even little things being done properly, we will in a few years have masses who have to that extent better skills and. more pride.

### **2. "Success breeds Success": "Nothing succeeds like Success"**

We have a problem that a large number of children drop out from schools. Even from families with tradition of learning, many are looked upon as "duds". Boys and girls who in normal life smart or at least average, do poorly in classrooms. These boys and girls either drop out or manage to scrape through because of pressure from parents.

There are many cases, each one of us would know, where someone who was a failure or second rate in school, shines in his profession. Why? because real life needs many more skills and qualities than required in school success. Yet boys with potential talent in other areas are branded, a "failure" and tend to drop out.

If a variety of skills are taught in the educational system, each one will have ample opportunity to succeed in one or the other and will get a boost to his morale so that he can persist in others at least he can go through school with a greater measure of pride and self-respect, I suspect in many cases, the 'failure' in book learning is due to lack of concentration and interest, arising out of non-relevance to their, real life situation. If learning of a variety of skills is an integral part of education and is made the basis of learning mental skills will, many who succeed in the former, that is physical and manipulative skills will feel encouraged and emboldened to master the latter, the mental skills.

### **3. Education is the Condensed Experience of the Past:**

Obviously we cannot absorb the total experience of all who have gone before us. To help absorb the maximum the experience of many individuals is generalized into knowledge stated in the form of laws, theories, and facts. Thus arise the disciplines of science, engineering, medicine, mathematics, geography, history, and even grammar, language and literature.

If we are going to condense all the knowledge harvested in the past and pass it on to the children as education, there are two ways in which this could be done. One approach is to list all the essential items to be conveyed and teach them through the books. The other approach is to list the key items and contrive a situation, where the children or students rediscover or find out for themselves the main concepts intended to be conveyed. The first approach of giving it through books is what is currently practised. This has led to unsatisfactory results and everyone is agreed in change towards the latter approach.

It is not possible to learn all ideas from the past by "rediscovering" them under controlled conditions. Only a finite number of laboratory or field, experiments / demonstrations can be arranged as part of education because of limited resources and time. While simple experiments can illustrate or demonstrate ideas, they do not necessarily show the relevance. Relevance is brought about by referring to real life situations. At present it is tacitly assumed that the real life situations are common to all students. In fact they are widely varying and therefore even when relevance is indicated by reference to real life situations - many students do not understand the relevance because they have never experienced the real life situation referred to.

#### Let us take some examples:

The city bred boys, do not need to burn wood as a fuel, they rarely watch the stars in the sky and could hardly recognize ten varieties of trees or birds, around them. The village bred boy would feel at home with trees and birds, could perhaps build a fire for cooking but would not know about electric trains or television or cold - pasteurized milk sold in bottles.

Won't it be a good idea to teach skills in doing things in the garden, in the home, handling tools, using materials - skills that every-one will find useful in everyday life. In doing these things as part of education to all, we build a common base of experience. And to this base of experience we can refer to illustrate new concepts or ideas.

This common base will not only make things relevant to all students but will also help to integrate all students irrespective of social background.

#### **4. Relevance of Education will be judged, by the Self-reliance and confidence of the so educated:**

The primary role of education is to prepare an individual to face the challenges of life. In the under-developed countries, the main challenges of life relate to earning a decent livelihood. In developed countries, where a reasonable living standard is assured, education aims at a "fuller" life.

If the above premise is accepted, teaching of skills becomes the primary functions of education. Why teach science at all?

Traditionally, craftsmen passed on their skills to their own children and also perhaps apprentices. These in turn became self-reliant craftsmen. Is this what we want to do now: The craftsmen passed on to their wards strictly limited skills. With a sort of inbreeding of knowledge within separate crafts and guilds there was no progress and only stagnation. Without the why & how, there was only limited innovation, lastly the choice of skills was limited to those relating to a particular trade only and so utilization of knowledge from other skills did not take place.

What we should, now aim at to teach skills used in endless variety of acts; the intention is not mainly to teach crafts but primarily to develop physical, manipulative and mental faculties. The selected crafts will serve as carriers for these skills. A skilled carpenter with a steady hand, an ability to visualize, a good judgement, could easily be trained as a welder or a plumber or a mason. Given the intellectual capacity, he would be perhaps a better experimental scientist than if he had not developed his craft skills.

As explained earlier, the teaching of skills, through a variety of jobs done, will give a wide enough base of experience, on which the science subjects could be taught so that the learner has an insight into what he has been practising, knows the whys and hows and would therefore be encouraged to develop further on his own, and make his contribution howsoever small to the fund of human knowledge.

The teaching of skills and science will thus compliment each other and produce the desired self-reliance and confidence.

#### **5. Life is one Continuous Education:**

Education should not just be the imparting of knowledge. It should be so done, that the student imbibes the spirit of enquiry and discovery, so that whatever, one does, one is slowly learning and life becomes one continuous education.

This principle is generally accepted but it is difficult -to implement. Different teaching techniques will afford, more or less opportunities in doing this. Even the printed matter can arouse the curiosity and encourage the reader to think, wonder and find out for himself. The printed matter can do this, most successfully only for people who have this quality - The book only focusses attention on a new area to investigate. The

very young who are just introduced to reading have to struggle to get meaning out of the book and cannot pick up the subtle thoughts.

Modern methods of teaching science include a demonstration or an experiment and then induce the student to arrive at the principle and then wonder why and how. These are a big improvement but have only a limited success. The enterprising students read ahead of their class and somewhere the principle is already stated and so he does not "arrive" at it. It is like a brain teaser in a magazine. If you know the answers are given on Page 124, you have a limited patience and if you cannot solve it you are tempted to look up the answer. Also the teacher knows the answer and his behaviour will be acting a part and never searching for an answer. In real life, the search much go on for months, years and may be for life. These experiments cannot teach the persistence in the search.

The Subject - matter of the experiment itself introduce a some limitations. If the school experiment deals with behaviour of gases or say effects of magnetic field - the students tend to think of experimentation only in the four walls of a laboratory. Even long practising scientists do not necessarily practise the same philosophy in real life.

On the other hand, let us say, the student is learning to lift heavy loads, use a rope for climbing up a tree or just planting a seed - the answers are not stated, at least not fully in any book, the teacher can only show one way to do it and not necessarily the best and it is easier to let the student find out for himself.

Teaching skills that are used in every day life provides a better medium to induce the spirit of experimentation as well as the methods of drawing conclusions where results cannot be quantified so easily.

**Knowledge becomes education when it is fully adsorbed and becomes part of the system:**

What is it that one remembers? One remembers what is strikingly different. One remembers things through association. One often remembers what we experienced, in the childhood. There is a good chance that an experiment with an unusual result will be well remembered.

But there are other things like the fall of objects under gravity which are part of the system and do not have to be remembered. If one has learnt swimming or cycling-in childhood, we never lose it.

The things that are practical soon become part of us and are never forgotten. If science education is imparted by demonstrating the why and how of the skills being practised, the chances are these effects will remain as long as the skills are retained, perhaps longer.

Education must have a multiplier effect:

With a very large and growing population, any system we chose must have the potential for exponential growth. The possible constraints on any such system are (a) Trained teachers; (b) Material facilities and (c) The demand.

The demand is the most important constraint. If the education is seen as beneficial compared to other systems of education as well as no education, there will be a demand. If the skills to be imparted are properly chosen it is natural to expect that these will help the learners in earning a living.

The section now normally well educated may tend to look at this as "education for the masses and not for the classes". This should not be so. The traditional learners will be better educated with the acquisition of skills.

What is true of students is true of teachers. Teachers are the same stuff as students. One generation ahead. One major difference - the age. Teachers will have to be given different skills and more important, they will have to be selected on a different basis. There is also a possibility -that after acquiring certain skills, the teachers may get better earning by practising these skills than by being teachers in a primary school. While this may hinder the spread, of the education for a while, it is to be considered a good indication-that the education is seen as relevant and produces self-reliance. This will certainly stimulate the demand and also more will volunteer for teacher training.

The resources; the building the land, the equipment are all essential. There is a possibility -that since various skills are taught and practised by students, a small fraction may be capable of bringing in some return. It is necessary to keep this income under watch - it should not smother the system and at the same time not allowed to die off- that would be a sign of growing irrelevance. The maintenance and acquisition of new equipment should be coming out of the systems itself.

In the primary classes, the basic skills will be imparted. These will be-  
**Maintenance:** Skills required in every day life for carrying on. These are the ones which children are or can be called, upon to do by themselves or assist. Some of these will not be recognized, as something that needs instruction. But these are better ways of doing even little things.

**Use of Tools & Devices:** Tools are what distinguish human race from animals. One should have familiarity with the use of as many hand tools as possible. The specialization will come later. A rope is not a tool but it is used in all walks of life and has multiple ways of using.

**Use of Materials:** Tools are used to shape materials. One must also get a feel in the working of different materials. This can go along with use of tools.

**Physical:** The use of tools and materials depends on certain physical abilities - strength, aim, agility, nimbleness of fingers, flexibility of body and limbs, stamina and courage and endurance. Whether these are called, skills or abilities, they can be developed by training and exercise. Sharpening of all senses is equally important.

**Nature:** We have to learn to understand, recognize and interpret the nature around us. The things around us are not to be seen as information – they must be seen as skills to be practised. To some extent these are the skills which the uneducated have and the educated have lost.

### **What Skills Should be Taught?**

#### **Compulsory:**

Maintenance

Use of Tools & Devices

Familiarity with materials of Construction

Physical

## Nature

Cleaning, Sweeping,  
winnowing  
Laundry  
Mending garments  
rafoo/darning  
Oiling  
Watering of plants  
Serving food  
Making a bed (home)  
Adhesives  
Packing  
Sharpening  
Lifting  
Carrying a flame  
Cooking  
Paint/white-wash  
Levelling earth/ ground  
draw st. lines  
Draw circles  
Dig trenches  
Repair shelters

Scissor  
Penknife  
Kitchen tools  
Axe  
Screw driver  
Saw (wood)  
Pliers  
Crowbar  
Shovel  
Pick-axe  
Sickle  
Rope  
Grinding  
Screening  
Wire  
Nails  
Hammer  
Flame

Clay  
Wood  
Paper  
Plastics  
Metal  
Glass  
Plants Points  
Cotton/Wool/Other fibres (silk, jute etc.)  
Leather  
Bricks  
Cement  
Wax

Plaster of Paris  
Asphalt

Walking  
Running  
Swimming  
Cycling  
Jumping  
Climbing  
Games  
First-aid  
Endurance  
Hygiene  
Sanitation  
Music & other arts

Skills in recognizing & interpreting  
Rocks  
Soil  
Sand  
Air/Wind  
Sky  
Clouds  
Stars  
Plants  
Animals  
Birds  
Insects  
Colour  
Light  
Sound

Specialisation:

Agriculture  
Poultry  
Apiary  
Horticulture  
Sericulture  
First aid  
Health Services

Masonry  
Carpentry  
Plumbing  
Wireman  
Painting

Welding  
Sheet metal working  
Smithy

Road construction  
Irrigation maintenance  
Bricks manufacture

Kilns/lime burning

Weaving

Dyeing

Tailoring

Plastic Fabrication

Art – Music

Painting

Sculpture