

Experience, reason and science education

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There has been a good amount of discussion in our country – through newspaper articles and television programmes – on what we should be teaching in our schools and how. This was initiated and sustained, as many of us may know, by the NCERT and its present director. The space here is not to detail the issues being discussed. Instead, I would like to go to those questions and issues that, in my view, make these discussions meaningful and worth pursuing.

It helps to understand how children learn, before one thinks about how to make them learn whatever we think is worth learning. Do they learn just like a young bird learns to fly, or better just like it learns to sing? Some may like to believe that by the time children attend to some serious and consequential learning, they are already on the predestined path, decided either by tradition that runs through their genes, or by the social milieu they are part of, by virtue of their family's money-earning capacities. And no amount of schooling, good or bad, will generally affect the destiny of these children unless, of course, they are exceptionally bright. At the other end is the high optimism of those schools and NGOs who would claim to make best out of the average students by providing them rich and practical exposure with their own unique teaching methods and skills. The role of a government body like the NCERT – as it has to cater to the whole of student population – oscillates between these extremities and strives to take solace in making the school bags lighter, in adding practical sessions to demonstrate theory, in adding technology to science and making it 'look' closer to the real world, etc. In doing this, I see us trapped at one end of that antique dichotomy between definition and demonstration, or between reason and experience, or (to be more philosophical) between rationalism and empiricism. While making our curriculum lighter, fun filled and closer to the day-to-day life of the child, we push ourselves to the extreme of 'dipping' students into either everyday or experimental experience. Like we dip a piece of sponge in water to let it absorb the water, we 'dip' our students in too much of the experience by asking them to observe, measure, repeat experiments, etc. In giving this empirical exposure to the stu-

dents, we think that, just as a piece of sponge absorbs water, students will automatically 'absorb' these experiences to form a scientific worldview. In a hurry to improve our educational system, we probably forget that humanity has been experiencing the same day and night cycles, but had to wait for long to remove earth from the centre of our universe. Slight variation among individuals of any species is such a commonsensical fact known to everyone, but putting it in the selectionist framework to explain adaptive organic change was left to Darwin: no one else before him developed the *idea* of natural selection. These examples teach us that the relationship between experience and ideas is not a simple one, in fact, studying how ideas are discovered is so difficult (there is no method to it!) that philosophers of science like Karl Popper left this mystic job for the psychologists.

It is possible to argue against the teachings of the above examples by saying that the examples are quite unique and even idiosyncratic. The aim of education in general, and science education in particular, is not to necessarily teach students to discover the structure of reality or to understand and explain our experiences in a new way. The aim of education is to make them understand science *per se*. But this argument is not of much help. Even if we just focus on the *content* of 'science' and the 'child' who learns it, what we largely see is that, in search of the effective way to communicate with the child, what is being employed is experience, primarily through demonstrations and experiments. The role of demonstrations and experiments in science education cannot be denied, but then it tends to be forgotten that in order to science educate, educators need to know more, both about science and about the child; we need to have in-depth working understanding of both history and philosophy of science as well as that of the child's psychological development, in general and in various sociological contexts. For example, we need to know exactly how 'Darwinian selection' is different from 'Lamarckian instruction', what did Darwin achieve by proposing the theory of natural selection, and why our children have

difficulty in understanding this theory – is it because they are disposed to reason in anthropomorphic or teleological terms? This will not only enrich the vision of science educators and policy makers, but would expectedly balance their efforts in changing curricula and teaching styles. The balance seems to have tilted too much towards 'experience'. It is believed that if we provide the child with the experience, for example, of variation – let us say of how leaves of the same kind of plant differ from each other – it will significantly help her in understanding what Darwin said. What gets entirely neglected in this alleged process of learning-through-experience is that it is equally, if not more, important to tell the child the role this variation plays in Darwin's reasoning.

No big claim like the present practice in curricular and systemic change is blind to the inputs from meta-disciplines, is meant to be communicated here. The issues are inherently more complex and messy than they look. There is a need, I suppose, for a *systematic* research in these areas. In our efforts to restore the role of reasoning in teaching and learning of sciences, the contribution of experience is not to be overlooked (after all, once we know that the earth rotates around the sun, it is so satisfactory to explain this experience by postulating the force of gravitation). It should always be kept in mind that the *object* of science education research is neither the meta-study of science (philosophers would do that) nor the study of child psychology (it is the domain of psychologists). But these meta-disciplines can significantly contribute to the thoughts and actions of educational researchers and may surely help in restoring the balance between the use of empirical experience and the use of reason in science education. Let us hope that various research institutes, including the initiatives of the Indian Academy of Sciences, would help in nurturing the research traditions relevant for science education research.

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