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Kuruvamma: tomorrow's scientist

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The world of science should bolster the self respect and confidence of a student

"Hundred degrees!" The chorus is loud and clear. I am watching to see that practically every child in the class has joined the chorus. We have been talking about water, and I have asked them what they understand to be the boiling point of water.

"Sure ? Not 98 degrees ? Or even 102 ?"

"No sir, it is hundred !"

"Hundred degrees what ?"

Only a few children answer now, but others join to repeat: "Hundred degrees centigrade".

I pause, look around, until all children look at me and ask softly: "How do you know?"

Many don't understand, some do. Some children giggle.

The discussion proceeds and it is clear that they are repeating what they have heard or read in the textbook. Many children in the class have seen a thermometer, and some have even used one to check body temperature. But does the clinical thermometer have 100 degrees Centigrade on it? They do not know.

Everyone accepts that this fact is easily verified experimentally, and that it is necessary to do so for it to be accepted as a fact "scientifically". How easy is it to do the experiment? There is some discussion about where a thermometer can be found, whether it can be borrowed etc. I extract a promise that they will get together and do it.

Then I tell them: "I have tried it several times and in many places and I have NEVER got 100 !"

The children are stunned. One girl ventures: "Not even once?"

"No, not even once. But I never got 75 or 120 either. It was always between 97 and 102".

After some discussion we get to well water, pond water, and how it is never "pure" water. It takes some effort to understand what books mean when they talk of the boiling point of water being 100 degrees Centigrade.

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This was an interaction in a village school, and the programme was called "Meet the scientist", where the children were mainly curious to see what a scientist looked like and talked like. Many were surprised (and some disappointed) that I spoke of such mundane matters and not of "latest discoveries".

Late afternoon, I take a walk in the fields nearby, accompanied by a bunch of bright and chatty children. My guide in chief is 12 year old Kuruvamma. Daughter of an agricultural labourer, she is amazed at my inability to identify most plants, some trees, many birds. She shows me which crops are planted where, and which should be grown next to which. She uproots plants, shows me the fine network of roots. There are some medicinal herbs, she picks some of the leaves for me, explains how I must use them.

Kuruvamma is at her best talking about plants, but there is one "problem" for me. She is convinced that all the material for making a plant comes from the soil, air plays little or no part. I try to explain, but it is awkward. Nitrogen fixation only makes her eyes glassy, and I give up.

We pass by a "shop" where jaggery is being made, and Kuruvamma gets me not only fresh sugarcane juice to drink but also some molasses to taste.

That night, the sky is resplendent. For a city man like me, used to citylights blurring the sky, this is a rare treat.

Kuruvamma is back at my side, and we point to constellations. She calls out the names of many, and I know them all, but not by the same names as her.

When it is way past time for her to go and sleep, I bid her farewell, I would be off early in the morning. I wish her well, tell her she will make a good scientist some day.

Kuruvamma's laughter rings out. "Science, sir? I never get more than 30 in science!"

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Science is a `compulsory' subject for the first ten years of schooling in India. We strive for universal schooling and insist that every child must learn science for ten years. Such a societal consensus clearly has some sound basis and clear expectations, though looking at any classroom, it seems quite hard to fathom that basis.

We should remind ourselves that it wasn't always like this. The 1968 National Policy on Education of the Indian Government was the first to suggest making mathematics and science education compulsory for ten years in school. This was confirmed by the 1986 Policy on Education as well. The latter argued for strengthening science and mathematics education, because, all areas of development are science and technology based and for that we need experts, middle-order workers and scientifically literate citizens". It specified how the

GUEST COLUMN

curriculum should be designed: “Science and mathematics curriculum will be designed for the secondary level for conscious internalization of healthy work ethos. This will provide valuable manpower for economic growth as well as for ideal citizenship to live effectively in the science/technology based society".

An interesting formulation there, and rather different from the tone one encounters in the National Curriculum Framework 2005 document. The latter says that science education should enable the learner to "acquire the skills and understand the methods and processes that lead to generation and validation of scientific knowledge". The emphasis is on processes, i.e., experimentation, taking observations, collection of data, classification, analysis, making hypothesis, drawing inferences, and arriving at conclusions for the objective truth. It speaks of cultivating "scientific temper".

In either case, what is very clear is the huge gap between the perceived goals of science education and what actually takes place in the classroom.

More significantly for this discussion, does Kuruvamma have any hope of joining the "experts, middle-order workers and scientifically literate citizens" that the former vision calls necessary? Or can Kuruvamma expect to understand the processes of science, internalize them?

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Today, we expect that the state guarantees the right to education for every child, and provides mechanisms for every child to access and participate in education till the age when she or he may enter the labour force. We further expect that a uniform curriculum and pedagogy, determined by social choice and ensured by social means, be available for every child. At the heart of such social constructions has always been the conviction that universal education is an instrument for social equity. Indeed, early struggles for universal education articulated social equity as the main justification for such a demand.

In India, science education operates in another dimension as well. The advent of mass education and western models of science education in this country was accompanied by an `enlightenment' mood. Science was seen as an important weapon in the battle against forces of obscurantism and superstition. Therefore science education was seen as an essential component of modernization and social transformation.

However, it does not take deep research to point out that the structure of social inequity, and its mechanisms of perpetuating inequity, are manifested in our schools, and science education, far from becoming an instrument of social transformation, merely reflects inequity. In terms of academic performance, which is the passport to economic upliftment, Kuruvamma has no hope of "becoming" a scientist. In terms of processes that encourage critical thought, that lead Kuruvamma towards freedom from fear and prejudice, school science seems to be of no help whatsoever.

Kuruvamma's identity as a rural dalit girl is not incidental to this discussion. That she is a first generation learner, that there are no books at home, let alone gadgets like pressure cookers, is relevant. That her school has no library nor laboratory, is important.

Kuruvamma is doubly impoverished: on the one hand, the idioms of modern urban science learning are alien to her -- no books on space travel, no newspapers speaking of Kalpana Chawla or Sunita Williams, no planetaria, no "science city", no internet, little access to new technology or its products. The state supplied text book is her sole link to formal science, and experiments are at best seen from a distance once in a few weeks, and at worst non-existent.

On the other hand, whatever Kuruvamma does know is rejected as not being science. Her extensive familiarity with the world around her, her hands-on experience with all processes around her, her ability to make things grow, to shape things and to connect to nature, are considered irrelevant. In school, she learns that whatever science might be, it is not something she is at home with.

It should be emphasized that Kuruvamma does need modern science, the secrets that books hold. She needs to travel beyond experiential learning which can often be superficial. All experience teaches her that matter is destroyed during burning, and she needs to develop a deep conviction in the law of conservation of matter. Kuruvamma needs to be invited into the fascinating world of science, but in a way that builds her self respect and confidence.

Kuruvamma needs, even more, the language of science that insists on quantification.

Kuruvamma *can* make a good scientist one day, but *will* she ? Chances are, she will not. Unless we take social equity in science education seriously indeed.

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