

Scientific temper and education: a framework for discussion

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Scientific temper is the use of scientific methods in areas other than natural science, like sociological and ethical issues. Acquiring scientific temper is a change in human behaviour and hence not a part of natural science. It gets strengthened not by studying basic natural sciences, but by applying scientific methods to human behaviour. The curriculum of all students (including scientists) needs to include social science and humanities for strengthening their scientific temper.

I have often wondered why a scientist in India is most reluctant to talk or write something about general matters, especially in the newspaper or media. So I was very happy to see the critical comments of Siddharthan¹ (IMSc, Chennai) about the article of Sarukkai² (a philosopher at NIAS, Bengaluru) on the 'March for Science' held on 9 August 2017. I was wondering whether I should intervene in the debate as I had disagreements with both of them. However, I was reluctant to write.

There were more responses³ from Sarukkai and Pathak (a sociologist from JNU, Delhi). Again I hesitated to respond. Then Surendran⁴ (a sociologist from TISS Mumbai), criticized both of them in a detailed way for their skepticism of and bias against science. She claimed that sociology is also a science and some sociologists had also marched with the scientists. Then came a sociologist of science, Thomas⁵ (Jesus & Mary College, Delhi) who criticized Surendran saying that her functional approach to sociology is not correct. Thomas claimed further that social scientists need not follow the scientific method, but can still claim to be scientists. With everyone except the last demolished, was there anything left to write or comment about? I began to see why scientists do not write. Before they move to the keyboard, the opposition seems to have demolished each other. Finally I thought I would write anyway, maybe in a more inclusive way, as the subject of scientific temper, in my view, is an extremely important one for the education of younger minds.

The main complaint against scientists by all the respondents was 'the claim that studying science reduces superstition and increases scientific temper is not correct. One has just to look at the personal lives and institutions of scientists; with a lot of superstition, casteism, sexism and other undesirable qualities'. I think this is true.

It is because scientific temper is a psychological attitude which is not influenced by doing routine science, but requires change in one's values and moral/ethical frameworks. In India, this is still largely decided by family and society. This has been noted by many persons, both scientists and non-scientists. Most of them agree that values and wisdom are outside natural science. Ethical framework decides largely our attitudes and behaviours. Still Siddharthan has a point. The sheer scale of the change in life and environment, due to science and technology, in the last 60 years has reduced the sanctity of superstitions. People do not worry about travelling south on Thursdays, as much now as earlier. I do not know about bathing with clothes on after an eclipse as some newspaper recommended recently.

To continue the discussion, it may be useful to look at the science/non-science divide from a broader perspective – the world view of an individual. World view is a collection of memory, knowledge, attitudes, values, vision and so forth; and is what guides and determines a person's thoughts and actions. We can start with I, at the centre of my world. As we move towards the outside, the world view has unreal dreams and imaginations, tastes and likings, many of them uncommunicable. Then come arts, humanities, social science and onto natural science like physics, chemistry on the outermost circle (or sphere). For the present discussion we will call the world view up to and including social science as the inner world and beyond that up to and including natural science as the outer world⁶.

The *outer world* is the objective or impersonal world, common to all human beings (us) which existed before my birth, holds me in it now and will continue to exist after my death. Though what happens after my death has no reality for me, I can visualize now, a world

that may exist even in my absence. It is the world of physics and other natural sciences. Emotion or feeling does not enter into the impersonal description of the outside world. Logic and scientific method (repeatability, falsifiability) are necessary. This world has a universal time and history. It is accessible to every individual through his or her perceptions. Science is related to the outer world and decides our knowledge of it, as well as its laws and evolution. Here the word 'science' refers to natural science; social science belongs to the inner world.

Human attitudes and social science

The distinction between natural and social science is important. As the philosopher John R. Searle⁷ (UC Berkley, USA) puts it 'The distinction, rough as it is, between the so called "natural" sciences and the "social" sciences is based on a more fundamental distinction in ontology (essence of things), between those features of the world that exist independently of human attitudes, like force, mass, gravitational attraction and photosynthesis, on the one hand, and on the other, those whose existence depends on human attitudes like money, property, marriage and government. There is a distinction, to put it in very simple terms, between those features of the world that are observer-independent and those that are observer-dependent. Natural sciences like physics, chemistry and biology are about features of nature that exist regardless of what we think, and social sciences like economics, political science and sociology are about features of the world, that are what they are, because we think, that is what they are.' The observer dependence that Searle talks about is different from the one in natural science, especially in quantum mechanics. Searle is referring to the dependence on

concepts and ideas expressed by the culture, society and state.

Observational uncertainties

One can have further gradations in social science depending on the nature of subjective involvement, as measured by the uncertainties in observations. The large uncertainties make individual observations meaningless. We have to have a large number of observations and use statistical methods for drawing conclusions. Smaller the sample larger is the uncertainty, as we can see in the predictions of economics.

The details of many of the above processes, like construction of the outside world, are subjects of study in themselves, especially in philosophy. In these disciplines many different theories can coexist (peacefully or otherwise). I quietly accept statements like ‘there is nothing natural about natural science’. How we agree on reality is still not unanimously agreed upon in philosophy, though most of us have worked out (hopefully) our own way of deciding what is real.

Differences in the working of the inner and outer worlds

The inner world includes humanities, arts and social science and all other areas outside natural science. Though this world is not part of science the scientific method, i.e. logic and reasoning, plays an essential role here also. However, repeatability and falsifiability do not exist; as controlled experiments are not generally possible and where possible have large errors or dispersions. Sometimes the word ‘soft sciences’ is used to describe these areas. Statistical methods are crucial for their study. To achieve objectivity in the study of these subjects is not easy. Detachment plays an essential role, though perfect detachment is not possible. Values and ethics are human attitudes. They are part of the inner world. This is why we say that (natural) science

and technology do not bring wisdom. Science is value-neutral. If one wishes to change the value system that one is born into, how does one decide on a new system of values?

Albert Einstein⁸ has said ‘Those convictions which are necessary and determinant for our conduct and judgements can not be found solely along this solid scientific way. Knowledge of “what is” does not open the door directly to “what should be”... the goal of our human aspirations. Fundamental ends and valuations... come into being not through demonstrations but through revelations, through the medium of powerful personalities. One must not attempt to justify them, but rather to sense their nature simply and clearly’. One makes a personal choice, consciously or unconsciously.

In the inner world, as we move closer to the centre, heart, rather than the head, is the decider. Love, compassion, kindness, elation, and ecstasy play a big role in decisions. In the outer world elation at the time of creation has to be followed by verification. Soft sciences do not have such an easy way out. There is the difficult problem of ‘empirical validity’. In the absence of experimental or mathematical proof, validity is by personal satisfaction. One example is ‘music appreciation’. Here personal satisfaction is a key factor, though opinions of other experts may also play a role. Personal satisfaction is accompanied by elation or happy feeling and decides our choice of good music. Elation at the highest level is the feeling of unity of ourselves and the universal self. This is of course going beyond positivism and materialism into metaphysics and theism or humanism.

In these areas, one has to live with uncertainty and try to validate conclusions to the extent soft sciences permit you. The acceptance of authority in the real world, however, does not seem to be based on validity alone. It is a mixture of charisma, social importance and the power wielded by the promoter of the idea, among other things. Hence use of logic, touch with reality and scientific

method to the extent possible, are absolutely necessary to tell us if the ‘emperor has no clothes’; that is to see the reality without being blinded by wrong public opinion. This is specially true in India, where godmen of all types abound.

This discussion has a special importance for education, which should provide guidance for personal ethical choices. Scientific temper involves looking at a problem, considering the various options and deciding what to do. Science teaching, in natural sciences, all over the world, is largely a transmission of skills (mathematical and experimental) and accepted ideas. It is not good at presenting alternatives to choose from and raising discussions. It is social science, which helps in making suitable choices and cultivating scientific temper. The diminishing role of social science in the total curriculum of science students, at present, leaves them ill-equipped to handle ethical issues and decide or write about them in newspapers and media. Thus the inclusion of scientific temper in the curriculum of every student is essential for meaningful education.

1. Siddharthan, R., *The Wire*, 12 August 2017.
2. Sarukkai, S., *The Hindu*, 10 August 2017.
3. Sarukkai, S., *The Wire*, 14 August 2017; Pathak, A., *Indian Express*, 12 August 2017.
4. Surendran, A., *The Wire*, 21 August 2017.
5. Thomas, R., *The Wire*, 23 August 2017.
6. The terms ‘world 1’ and ‘world 2’ are used by Popper, K. (1974/2002). *The Unended Quest*, Routledge classics, London, in somewhat different contexts.
7. Searle, J. R., *The New York Review*, 28 February 2002, pp. 33–36; see also his book *The Mind*.
8. Einstein, A., *Out of My Later Years*, Philosophical Library, N.Y., 1950, pp. 21–23.

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