

Teaching of the Scientific Method in High Schools in India

Jaideep Talukdar

Department of Basic Sciences and Humanities Silicon Institute of Technology, Bhubaneswar, Odisha, India

The Scientific Method is the tried and tested way we conduct a scientific enquiry. It is the basis of our insight into understanding natural phenomena and human-engineered processes. As eloquently put by Goldhaber *et al.* [1] “*The scientific method is a body of techniques for investigating phenomena, acquiring new knowledge, or correcting and integrating previous knowledge*”. The roots of this method lie in the approach used by some ancient scientists of the Greek era like Socrates, Aristotle and Archimedes and during the Middle Ages by some Arab scientists like Al-Baruni and Ibn al-Haytham; however, the method was formally adopted by contemporary inquisitive minds like Francis Bacon, Rene Descartes, Galileo Galilee and Isaac Newton around the 17th century [2]. In our

current state of scientific knowhow and knowledge, this method is the cornerstone of all scientific methodology, and is the basis of technical and journal articles in science and engineering. The method has gained universal acceptance and is utilized in almost all branches of science and engineering, including physics, chemistry, mathematics, biology, and varied branches of engineering.

The introduction of the Scientific Method in grade schools is the primary objective of this article. The question arises, at what stage in academic pursuit must this all-important technique be introduced to students and practitioners of science and engineering? Traditionally, in India, it has been done at the post-graduate level in courses on Research Methodology, with the intent of setting up a structured method for the researchers to adopt. In the undergraduate curriculum in science and engineering, (at the BSc or BTech level) very rarely does one come across anything even remotely resembling the scientific method and hypothesis testing, other than maybe in a course on Statistics. This, in my view, is a serious and glaring weakness in our teaching of science in India that should be immediately addressed, and hopefully the gap is bridged soon.

| Access this article online | |
|---|---|
| Publisher | Website: http://www.ndpublisher.in |
|  | DOI: 10.5958/2321-5771.2016.00003.X |

Address for correspondence

Jaideep Talukdar: Humanities Silicon Institute of Technology, Bhubaneswar, Odisha, India

E-mail: jtalukdar@yahoo.com

In the USA for example, the scientific method is introduced in various classes of science at an early grade-school level - sometimes as early as 4th grade, with catchy names like 'School of Dragons' and 'Ducksters' thrown in [3,4,5]. The core structure of the method is the same; however, the verbiage used is something that middle-schoolers can understand. The word 'hypothesis', integral to the scientific method, is retained as no real legitimate substitute word can convey the exact same idea. Subsequently, throughout middle and high schools, the students see the scientific method in action in various science subjects; specialized material has been developed to facilitate understanding by children at this level. Very often, interesting activities revolving around this method are also given to the students, to get them acquainted with the concepts involved. This early introduction is of paramount importance as it sets the stage for possible prospective researchers to pursue avenues of research in a methodical manner.

Based on personal observations from a limited number workshops and seminars on technical communication, where participants consisted of science or engineering faculty members, it was found that a noticeable percentage of them could not correctly establish what the hypothesis was, after reading a journal article pertaining to a general related area. They readily accepted and understood the hypothesis once it was explained to them by an instructor. Could an early introduction to this important scientific methodology significantly alter a person's ability to understand and implement related ideas in the future? In my opinion, the answer is a resounding yes. In fact, it may be one of the subtle underlying reasons why our research

in general is lagging behind in more ways than one. Personnel communications [6] and a realization that the status quo needs to change as regards this aspect of the teaching of science, have compelled me to voice this opinion to the scientific community in India.

Nothing beats learning early. So why not introduce the 'Scientific Method' as a segment of every science subject in high school? At the very least, it'll help foster a culture of asking questions and creative thinking, which are the core elements of research. It is hoped that policy makers in the educational field take immediate notice and start revising the pertinent middle and high-school syllabi accordingly.

REFERENCES

- Goldhaber, Alfred Scharff; Nieto, Michael Martin. January–March 2010. "Photon and graviton mass limits". *Reviews of Modern Physics* (American Physical Society) **82**: 939–979. doi:10.1103/RevModPhys.82.939.
- History of the Scientific Method, Wikipedia, https://en.wikipedia.org/wiki/History_of_scientific_method
- http://www.biology4kids.com/files/studies_scimethod.html
- <http://www.ducksters.com/science/scientificmethod.php>
- <http://www.schoolofdragons.com/how-to-train-your-dragon/the-scientific-method>
- Personal Communications, D.Seiken and C. Singareddy, Portsmouth, NH, USA