**UNESCO-DST-CSIR-MHRD-INSA**

Seminar on

# Building the Scientific Mind

22 August 2005


## A Report

**Indian National Science Academy**
Bahadur Shah Zafar Marg, New Delhi

## Introduction

A one day seminar on “Building the Scientific Mind” was held at the Indian National Science Academy, New Delhi on 22nd August 2005 in collaboration with UNESCO, CSIR, DST & MHRD.


The seminar was organized keeping in view the multifaceted objectives. The creation of a scientific mind set has traditionally been seen as the domain of science educators. This is too narrow a view and hence there is need to broaden the perspective. The need of the hour more than ever is the development of scientific mind in context. The call to focus on the scientific mind as a dimension of human capability beyond its application in the advancement of science per se comes from scientists themselves. But most of the issues that vex humanity daily cannot be solved without integrating knowledge from the natural sciences with that of social sciences and humanities. These considerations provide a strong argument to take a fresh look at what is required to foster the development of the scientific mind in a life long and life-wide perspective. Therefore the call for a debate and action to tackle various questions. The questions that would eventually a) help in understanding what the scientific mind entails and how it relates to, and is relevant for, multiple aspects of human endeavor, including the advancement of scientific knowledge, insight, and know-how and the like; b) generate ideas and strategies about what the key conditions are, that promote and facilitate the continual development of a scientific mindset as an essential ingredient of the human capability to deal with complex problems in context.

## Participation

The seminar had over 140 participants from multifaceted domains and age groups ranging from 14 to over 80, who took active part in the deliberations in various sessions.

## Inaugural Session

In the opening session while welcoming the invitees and participants, Professor M Tawfik, UNESCO representative said that scientific mind needs curiosity, open mindedness, honesty, humility and ethics. India can play exemplary role in building a society with scientific mind.

Dr R A Mashelkar, President, INSA in his remarks said that essence of scientific mind is openness. It is the explanation of nature of realities. The work done by a scientific mind are observed and verified. A thinking man has unfettered reflections. Science education is an important area to concentrate if one wants to build a scientific mind. Scientific mind is otherwise an information based management technique. The building up of scientific mind is not restricted to developing countries alone. Even the advanced countries are lacking in it. Let us all take effort to make this century a century of scientific mind, he opined.


Shri Kapil Sibal, Hon'ble Minister for Science & Technology and Ocean Development said that Science is the exploration of the realities of nature. There has been a constant battle

between the human being and the powerful nature to understand its realities. Science involves folking ethics, morality and philosophy. There should be a thrust for knowledge. Appropriate environment needs to be created to encourage questioning from very young age itself, that is where the journey for scientific mind should start. Autonomy of thought process is a stepping stone for having scientific mind. Essence of democracy is freedom of speech and right to dissent is the essence of having scientific mind. The fundamental of democracy is not mere the electoral process but the substantial proportion of this democracy entails a political process which can allow a scientific mind to flourish. True democracy is the means equality of opportunity, he stated. Shri Sibal ended his address by quoting Elbert Einstein "The whole of science is nothing else but understanding of our daily living".

Dr Jan Visser, Founder and President of Learning Development Institute, Netherlands in his keynote address entitled: "Unfolding the Scientific Mind: A stepping stone on the way to mindful learning" said that the scientific mind exists in all, but it is the unfolding of the same and is an ongoing effort. *You can't build someone else's scientific mind, but you can build your own. Besides, you can provide the bricks and mortar for people to do the building themselves and help them acquire the necessary skills. While focusing on the m*ost frequently heard reasons about why it is important to promote the scientific mind, Dr Visser stated that Society needs scientists. Countries that don't produce good scientists will be left behind. It is mandatory for ordinary citizens to get to know of scientific activities and they must understand what science and scientists create. The involvement of the public is a must for the building of a scientific mind. A scientific mind is creative essence of who we are and to understand the extent of complexity of problems we face. According to him, the essential features of a scientific mind are: inquiring, imagination/creative thought, envisioning/prediction, collaboration, dialogue – including respectful dissent; independence of thought; tolerance of thought of others; practice of establishing ways of coming to agreement, construction – building on existing knowledge, seeking beauty, integrity, wholeness, parsimony. Mind, which is memory both static and dynamic while creation of the scientific mind is the personalization of the physical brain through our experience. Beyond science, there is a spirit of science, which is not necessarily fed by science. He opined that adoption of local language for science learning to be promoted. While focusing on teaching attitudes, he suggested that society *must leave freedom for the mind to wander about in trying to solve*

*problems* There is only a limited role in schools for building a scientific mind. It requires a multiple setting like family, school, media clubs, work places, extension centers and communal living. While concluding Dr Visser quoted his daughter (Yusra Laila Visser, 1997) “we live, we are all *memories in the making*”

The vote of thanks was proposed by the Convener, Dr V S Chauhan who also briefed the participants about the schedule of the day long deliberations.

## Session I: Thematic Presentations


The opening session was followed by three presentations on the theme of the seminar. The session was chaired by Dr R A Mashelkar and Dr Kanury V Subba Rao was the rapporteur.

Profesor R Rajaraman spoke on “What is Scientific Mind” and stated that it is an abstract mental concept of mind studying the mind. He pointed out that if we wish to propagate a scientific mindset in society, we must critically re-examine the tenets of this mindset. While focussing on various tools of building up of a scientific mind, he opined that following scientific method is a critical tool. Observations should be objective, accúrate and reproducible that would conform to places, times, samples and observers. One should then have adequate theory to correlate and explain the observations. The theory should be consistent, logical, based on simple hypóthesis and should lead to further experimentation. If one possesses experimental skills, s/he is capable of using scientific methods. It is immoral and infeasible to attempt to propogate a scientific methods particularly in certain societal issues. A scientific mind has a larger awareness, and is skilled in using scientific methods and appreciating its context. Scientiic mind does not order alternate routes to knowledge. While referring to the issue of whether scientists believe in scientific mind, Dr Rajaraman opined that they do have a scientific mind; some have scientific mind in work and spiritual belief in personal life which may not be hypocrisy but healthy

and a virtue, leading to more holistic lives.He cautioned that the society should be beware of Science Cheerleaders. If *science* is used as an instrument by political entities for weeding out inconvenient cultural and religious underpinnings of people, it can be dangerous. Unless major S&T applications are tempered with a deep awareness of their impact on the all aspects of society, the cultural, the aesthetic, and the spiritual, they will do more violence than good. Educate the public on the goods and bads of various issues and do not prevail upon, he highlighted. While concluding Dr Rajaraman said that what we need is "*Scientific Mind in a Human Face".*

The next presentation was made Dr Satyajit Rath who spoke on why we need a scientific mind. A scientific mind is one that looks for causality that thinks about future predictions and is one of imagination, curiosity and honesty. Science or scientific mindset is necessary to provide us with the ability to modify our environment to our advantage, usually through technological creations. The twin pillars of scientificness, imagination and curiosity would not lead to dependable prediction of the future unless they are coupled with honesty and humility. Science uniquely allows us to achieve dependable, communal understanding of the issues that makes one less confident and somewhat skeptical. The more we understand the less is the fear. Therefore the fundamental point of scientific mindset is to get the harmony of comprehension. Science does not create technology but could be an enabling mechanism for its development. Dr Rath said that we need a scientific mindset for a vibrant communal, individually driven, cooperative effort so as to fullfil the main societal purpose of the scientific enterprise to think of causality for itself. The empowerment of the society by the scientific enterprise is obviously connected to the teaching of Science we need to identify the teaching of science in our schools and colleges as a glorious activity. While focusing on the need for scientific mindset, Dr Rath stated that one needs to a) create a group of people who will do outstanding work in science, b) provide a conceptual terrain for innovative minds to find simple solutions to the complicated problems, c) understand the world around is, d) make ourselves as people who will live science in the daily lives, e) better understanding the society to make better policies.

This was followed by the third presentation by Professor Narender Kumar on how to build a scientific mind. Building a scientific mind starts with looking around and asking questions. Once a problem is identified, fragment the problem to smaller components, that will help in finding the solutions. This in essence is scientific enquiry of the curious mind. The involvement of the mind and engaging it in a

disciplined way is also essential for building a scientific mind. One way to do this

is to have a interactive, problem solving session. Wherein having identified problem, one needs to go about solving it firstly through approximations and models. In finding a solution to the identified problem, one should focus on the problems and finally share a passion for science through discussing specific real life examples of how science was actually done and discoveries made through keen observation. A scientifically imprinted mind must feel empowered. This applies not just to the professional scientists in the national laboratories and the universities, but to all – be it a farmer, a mechanic, or a common citizen. We must not cease to question, we must question ceaselessly, he emphasized.

## Session II: Panel Discussion


The afternoon session started with a panel discussion on "*Critique on scientific mind in scientific community,education community, media, government, parliament, NGOs and Civil Society in general".* The session was chaired by Dr Jan Visser and Dr Satyajit Rath was the rapporteur. The panelists included Professor V G Bhide, Dr Kanury V Rao, Professor P S Ramakrishnan, Dr Subadhra Menon, Dr Ashok Jain . Each of the panelists highlighted the aspects of a scientific mind in relation to their area of specialization. The discussion was then opened to the floor. There were several interesting observations and interventions made by the participants to which the panelists responded. The outcome of the panel discussion were the following.

- ✓ The gap between the formal and informal knowledge need to be bridged.
- ✓ Unless building the scientific mind or temper is related to societal concerns, it does not mean much.
- ✓ The formal education system dissuades children from asking questions. This attitude kills the curiosity in the young mind and thus becomes detrimental to building a scientific mind.
- ✓ Innovative learning requires trial and error approach. Unfortunately the time constraints faced by the schools, these sorts of innovativeness are not encouraged by the current educational system
- ✓ The present education system need to be overhauled
- ✓ Scientific literacy is different from the understanding of science. Therefore, innovation and exploratory method of learning should be encouraged.
- ✓ Process of building a scientific mind begins right from the birth of a child, hence nurturing the scientific bent of mind begins right from pre-school ages.
- ✓ Institution of a fellowships to encourage people to take up journalism as a career would help in the building of a scientific mind.
- ✓ There was a strong concern about initiating a course on popularization of science leading to formal degree/s in higher education system.

## Session III: Parallel Working Groups

The panel discussion was followed by two parallel working groups focusing on: (A) Scientific mind in the pre-school and school ages and higher education; (B) Scientific mind in the media, political life, government, parliament, NGOs, civil society in general.

The working group 'A' was chaired by Prof. G.D. Sharma and Dr. Babuji and Ms. Usha Menon were the rapporteurs. The session witnessed active participation of large number of participants which included young minds from schools, school teachers, scientific and academic community. After a briefing by the chairman on the needs of a scientific mind among the education community in general, the topic was open for discussion by the participants. Many students and teachers made valid points as to their agreement on the need of the scientific mind. However, they were all of the

opinion that lack of time did not permit them to pursue this seriously. There were strong opinions and suggestions expressed by the participants particularly children and the teachers on the issue of inculcating the scientific mind right from the pre-school and making it a lifelong and lifewide endeavour. Further to the deliberations, useful suggestions from all age groups and all domains were arrived at, that have been reproduced in the concluding session- Working Group A: Highlights.

The working group 'B' was chaired by Dr Anuj Sinha and Ms Parvinder Chawla was the rapporteur. The participants of this working group were truly multifaceted in their professional domains ranging from scientific community to government, parliament, media, NGOs, civil society and the like. The amazing part of the participation was the brilliant school children who were though not directly involved with these domains, yet exhibited tremendous enthusiasm and came out with exceptionally brilliant ideas. Further to active discussions a number of suggestions came up for consideration of initiating actions/activities that are reflected in the concluding session as Working Group B :Highlights.

## Session IV: Concluding Session

The concluding session was chaired by Dr V S Chauhan, where the presentation of the highlights of deliberations were made by the Chairpersons of the respective working groups.

### *Working Group A : Highlights*

- ✓ Recognise the problem and then try to find a solution. The solution may come sooner or later but one needs to keep trying without losing the track.
- ✓ Encourage the habit of questioning by children at all levels. This would help in building their inquisitiveness.

- ✓ It would be worthwhile to cite day to day or real life situations to explain abstract scientific concepts. This would encourage the students to relate whatever one studies to some real life happening, thereby creating a scientific mind.
- ✓ Encourage organizing science clubs at various levels to give an opportunity for the young mind to reveal its innovativeness.
- ✓ The concept of questioning the question is also a way to encourage building of a scientific mind.
- ✓ A fair amount of openness be maintained while teaching advanced scientific topics so that there is scope for thinking and developing further.
- ✓ If appropriate attention and time is given to hands on sessions, the understanding of the concept becomes more meaningful and life long process for subsequent exploration.
- ✓ An interactive method of teaching and learning need to be adopted in order to stimulate the inquisitiveness of the learner.

***Working Group B : Highlights***

- ✓ Importance of scientific rationale need to be stressed and the methodologies to achieve these to be discussed.
- ✓ Building a fellowship program to attract young talent into journalism.
- ✓ The electronic media like the television and the internet need to be involved more in science programmes.
- ✓ Internet to be used as a means to motivate communities as a passion for exploration.
- ✓ Renowned science writers must be encouraged to write for the internet providing enrichment matter for any curriculum.
- ✓ A strong link is needed between science communicators and the society in order to build knowledgeable communities.
- ✓ Amateur radios can be used for the popularization of science.
- ✓ Undertaking partnership projects is essential so as to involve students and lay public, which would help in creating a scientific mind.
- ✓ Setting up of a library for schools, organising teacher training programmes, chat sessions between students and scientists would also go a long way in developing a scientific mind.
- ✓ Concept of science centers in villages must be encouraged. In these community science centers, scientists can interact with school children and other general public for communicating the importance of science as a tool to solve their societal problems.
- ✓ Exploratory way of learning science is a joyful experience. Experiments can be simulated on the computers and copied onto CDs which can be made available for the schools.
- ✓ Science forum in the parliament need to be revived as decision making has become more complex. This would systematize national policy making.

- ✓ Politicians to spend some time in scientific institutions to understand the essence of doing science.
- ✓ The scientific achievements of constituencies of parliamentarians can be recognized based on their scientific index.
- ✓ S & T articles need to be written for various newspapers. Thought processes which have led to major science discoveries need to be highlighted in the media so as to develop a scientific mind.

Dr V S Chauhan in his concluding remarks, stated that by and large the aim with which this seminar was organized has been achieved. However, we need not to stop here but take it forward Today's deliberations have laid the ground work for follow up activities aiming at creating propitious conditions for the development of the scientific mind in a life long learning perspective involving the various stake holders. He thanked all the speakers, participants, chairpersons, and rapporteurs, for their active participation and fruitful contributions.