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RESEARCH ARTICLE

25 Years of Public Understanding of Science in India: Analysis based on cultural distance

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ABSTRACT

About 30 years ago the idea of cultural distance between peoples structure of thought and the science was proposed. Over the years it crystallised. This article presents major findings of the surveys that were conducted in India, spanned over twenty-five years. It is argued that cultural distance varies depending upon the nature of scientific information. Mapping cultural distances of specific scientific information for distinct target groups could help planners and communicators of science in devising effectual intervention strategies. Plans for dissemination of information that has low magnitude of cultural distance, need to be radically different in nature *vis a vis* approaches required for popularising scientific ideas that tend to cluster at the farthest end of the scale. In developing countries, the formal system of modern education operates as a strong determinant in shaping the cultural structure of thought prevalent among the citizens. It influences the worldview of even those who have never received any formal schooling and are categorised as 'illiterate'.

KEYWORDS: Cultural Distance, Public Understanding of Science, Scientific Literacy, Science Engagement.

Science and the Public

The debate on science and its relationship with the public is almost as old as emergence of modern science. It has been argued that the nature of the discourse has undergone radical changes (Raza et al., 2002). The percolation of science to the general public is mainly restricted by the linguistic intricacy associated with science, which is not consonant to the people's culture.

During early period the term 'science' used in a narrow sense to refer just to the 'physical' or 'natural' sciences' but social scientists started looking at social aspects of science and developed

different nomenclature for it, in 1930s (Collini, 1993). Mathematics and mathematical symbols notations and equations became integral part of science in order to substantiate results and its communication. But the distance between science and public is obvious because of inherent characteristics involved in conducting science (Bernal, 1938). The cultural aspect between science and people, in addition to knowledge-lag, was also suggested by social scientists (Bernal, 1938; Snow 1993). This led to the debate all over the world among intellectuals who contributed to the issue by developing distinctive arguments (Tylor, 1924; Levis, 1962; Durant, 1993; Sardar and Loon, 1997 and Geertz, 1999). As a consequence of work being carried out in the area, various terms like scientific literacy, science communication, public perception and opinion about science, public engagement of science, public understanding of science, science as/and culture, science and society, etc, emerged and research initiated for looking into social aspects of science and technology.

It has also been argued that the cultural boundaries offer resistance to transfer and absorption of ideas generated in one cultural setting to the other, irrespective of subject involved. It still continues to do so in today's world in spite of the fact that the era is marked with globalisation and universalisation. The permeation of scientific ideas to other culture is no exception. Reception of scientific ideas and information among the public remains a complex cultural process and is a subject matter of deep interdisciplinary investigation for researchers and practitioners of science communication. Though, it has been argued that the rapid and ever increasing pace of expansion in science and technology has generated close association of science and public (Fayard, 1994).

Scientific Literacy

Many researchers have tried to define 'scientific literacy', yet the term has defied a precise definition since it was introduced in the late 1950s (Hurd, 1958; McCurdy, 1958; Rockefeller Brothers Fund, 1958). Although it is widely claimed to be a desired outcome of science education, not everyone agrees what that means. The problem is magnified manifold when scientific literacy becomes the objective of science education.

Without a clear idea of what scientific literacy is, reform becomes a vague notion at best. Many attempts have been made to define it, but none has yielded anything that even approaches universal acceptance. There are a number of reasons for this. Most important is the fact that scientific literacy is a broad concept encompassing many historically significant educational themes that have shifted over time. Some scholars have even admitted that it may be no more than a useful slogan to rally educators to support more and better science teaching (Bybee, 1997). If that is true, then to speak of scientific literacy is simply to speak of science education itself.

It is also argued that instead of defining scientific literacy in terms of specifically prescribed learning outcome, scientific literacy should be conceptualized broadly enough to pursue the goals that are most suitable for their particular situations along with the content and methodologies that are most appropriate for them and their students. This would do more to enhance the public's understanding and appreciation of science than will current efforts that are too narrowly aimed at increasing scores on international tests of science knowledge (DeBoer, 2000).

International Efforts in Public Understanding of Science

During the past twenty-five years or so in USA, UK, Canada, France, Germany, Japan, Korea, China, Latin America, etc., national centres for monitoring the shifts in scientific awareness level and for carrying out studies in the area of Public Understanding of Science (PUS) have been set up. These groups have administered research projects based on regularly conducted large-scale national surveys to probe some of the dimensions.

Though the initial efforts in the West have left a deep influence on present day survey studies, most scholars rejected the framework by the mid-nineties. 'Scientific literacy' or 'Deficit' model of analysis, is Eurocentric; simple and addictive as it is, it has not been replaced by any other universally acceptable analytical framework. However, the demise of the 'deficit model' unleashed the possibility of many other conceptual and analytical models for probing the public understanding of science.

Researchers and thinkers working on public understanding of science and Thomas and Durant (1987) detected the presence of a number of ideas about and aspects of interest in the public understanding. They tried to provide preliminary account of the nature of the public understanding of science in terms of the concept of scientific literacy to bring focus on the relationship between science and the rest of society. Comparative analysis on public understanding of science between American and European revealed that American are more attentive to issues of science and Technology compared to European on average. But Europeans are able to provide answers to more complicated question than American (Bauer and Durant, 1992). Other researchers around the globe have developed their arguments on different aspects of public understanding of science, such as science and culture in Canada (Shiele, 1994), social aspect of science in Korea (Kim, 2007) museum and science in Brazil (Massarani et al., 2005), Epistemological aspect of PUS in South Africa (DuPlessis, 2012) and in China an independent institute for popularization of science (Chinese Research Institute for Science Popularisation, CRISP) under Chinese Academy of Science and Technology.

Indian Scenario

In India, investigations into people's understanding of science in the country has been pioneered by researchers working at Council of Scientific and Industrial Research (CSIR), Ministry of Science & Technology, Government of India. These investigations have been conducted in active collaboration with the National Council of Science & Technology Communication (NCSTC), Department of Science and Technology (DST), New Delhi.

Since the research on public understanding of science in India was an offshoot of a widespread pan-India civil society driven science movement, it had different concerns, which determined the broad objectives. The 'Peoples Science Movement', a conglomerate of many civil society organisations, with the participation of thousands of volunteers, aimed at reaching modern science to the lay publics in India.

The team members who initiated public understanding of science research in 1985 in India were actively involved in conceiving and executing some of the large-scale science

popularisation projects. The last few decades have witnessed the development of instruments for measuring people's understanding of science, perfecting the methodology of field surveys, analysis and presentation of results of significant indicators. The studies by the team during Kumbh Mela 1989, Ardh Kumbh 1995, Kumbh Mela 2001, Ardh Kumbh 2007 and Kumbh Mela 2013 by CSIR are seminal contributions to this emerging field of research.

The team, however, realised that the framework, methodology and indicators developed by Jon Miller, et al. could not be applied to probe the peoples' structure of thought in India. The US and Eurocentric instruments of investigation had two serious lacunae. On the one hand, these could be used, at best, for carrying out cross-regional and cross-national comparative analysis and, on the other hand, they did not provide any insight for propagating science to the lay public.

Questions such as why certain scientific ideas, created in laboratories, get propagated comparatively faster than others and become part of peoples' thought complex or what role formal education, gender, occupation, etc., play in determining the propagation of science to the lay public, were not posed by researchers in the West. The deficit model divided the public into two categories — 'Scientifically Literate' and 'Scientifically Illiterate' — and developed indexes for functional, cultural and civic scientific literacy.

The basic research questions that we asked before launching the first survey were: Who do we focus on, those who are so called scientifically literate or those who could be declared as scientifically illiterate? Do we consider an individual as unit of analysis or is it the response to a question that should be the focus of the study? Why do certain scientific tenets, laws and information elicit high percentage of scientifically correct responses from a given set of cultural sub-group?

Answers to the first question led us to the understanding that no citizen could be designated as scientifically illiterate, even if s/he has not been acculturated into modern science. A farmer who has never been exposed to modern education and science uses accumulated experiential knowledge and relies upon scientific methods while performing his agrarian daily tasks, even if s/he relies on superstitious extra-science rituals in other domains of life.

Before embarking on a large-scale survey at the Kumbh Mela (Bhattacharya, 1983) in Allahabad, in 1989, indicators and a schedule for interviewing the respondents had to be developed. In order to probe the thought structure of the public it was decided that the unit of analysis should be response. Thus, the second question led us to develop categories of responses instead of individual respondents.

In order to achieve the objective of communicating science to the public effectively, it would have been a futile exercise to measure what percentage of respondents gave scientifically correct answers. Such conclusion could not have helped in developing the strategies for increasing the efficacy of science communication in the country. It was important to develop a scale on which responses could be mapped and operated upon for statistical analysis.

For this four categories of responses were developed. These categories were 'scientifically correct', 'scientifically incorrect', 'extra scientific' and 'don't know'. The scale so constructed is further explained in the following sections.

The third question led to refining the framework for probing the thought structure of the public. It was apparent from the literature available that some of the demographic parameters such as education, gender, exposure to media channels, etc., were strong determinants of public understanding of science. However, the percentage of scientifically correct answers rendered by a target group changed quite substantially across the indicators chosen for the investigation.

Much later, Chinese scholars who developed the 'difficulty index' for each indicator provided a simplistic answer to this observed pattern. Under the influence of the deficit model, the Chinese team, which carried out the scientific literacy surveys (Chao and Qi, 2011), did not probe the causal relationship between nature of scientific information and the percentage of correct answers rendered by the populace.

In India, realising the importance of peoples' culture as a strong determinant of thought structures of a common citizen, the research took a different direction. It was amply clear, even at the initial stages of research, that the scientific ideas are produced, refined and filtered in a culture during the process of

communication and before these are accepted within the thought structure of the public. The scientific method of configuring material reality is far removed from peoples' culture. In other words, there exists a cultural distance between science and the public. Thus, the question as to why certain scientific facts and explanations to natural phenomena are absorbed within the publics' structure of thought, with lesser efforts and at a faster pace compared to other scientific explanations, led us to the 'Cultural Distance Model'.

Curiously, it was observed that a cultural distance separated the 'peoples' cultural thought structure' and the 'scientific methods of configuring reality'. This cultural distance was determined by factors that could be categorised as extrinsic and intrinsic to scientific knowledge under scrutiny. All demographic factors such as education level, age, occupation, gender, exposure to information channels, etc., are extrinsic to scientific information, yet these factors impinged on or accentuated propagation of scientific information.

Most studies focus on these factors for obvious reasons, foremost being that it is easy to record the demographic profile of respondents and perform statistical tests on the data. The intrinsic factors that control the cultural distance of a scientific phenomenon were 'life cycle of the phenomenon', 'the control that an individual or group could exercise', 'the conceptual and mathematical skewness involved in explaining the phenomenon' and 'the intensity with which the phenomenon intervenes in the life of the group under scrutiny'.

With this framework, quite clearly, each piece of scientific information and explanation selected as indicator for probing the public understanding of science could be placed at a specific cultural distance from peoples' thought structure. And finally, it was not difficult to construct a scale on which four areas – 'astronomy and cosmology', 'geography and climate', 'health and hygiene' and 'agriculture' – could be placed at varying degrees of relative cultural distance.

Public Understanding of Science Survey Studies

Administering a national survey is an expensive undertaking. In most developed countries specialized agencies carryout survey

and the research scholars who later analyse the data are completely delinked from actual execution of a survey. In developing countries including India, South Africa and China, research team handles entire survey operation. From designing the questionnaire to analyzing the data and producing reports is done by a team of scholars. This gives them a deeper understanding of social reality and help in arriving at conclusion.

The first ever survey of public understanding of science was conducted in India 1989 during Kumbh Mela held at Allahabad, Uttar Pradesh. Subsequently administering surveys became a regular activity. However, unlike most countries where national PUS survey studies were undertaken, in India paucity of funds available to this emerging area did not permit a national sample survey. In the western countries prevalent 'homogeneity in cultural, economic and social spheres permitted smaller sample sizes to statistically represent the entire national universe. Working out a statistically representative sample in a culturally rich and diverse country such as India or China is a convoluted exercise. India, in terms of human resources, is a large and complex country and therefore in order to draw a stratified national representative sample, which take into account all the social, economic, linguistic, religious and cultural variations, is not an easy task and executing such a survey exercise is all the more difficult. Therefore, to capture features, if any, arising out of the in-homogeneity in the social and cultural contexts of the 'Indian' public, the first two surveys were conducted at sites, which were culturally, economically and socially different milieus.

Twenty-five Years, Five Surveys at Allahabad during Kumbhs and Ardh-kumbhs

India being a culturally and linguistically rich and diversified country presents a complex mosaic for any socio-cultural investigation. However, survey study is an expensive undertaking. The Kumbh Mela the largest congregation of human beings anywhere in the world, takes place every 12 years at Allahabad. People from all parts of the country and every strata of society congregate in the month of January and February at Allahabad for attending the event.

By the time the research team was ready with the conceptual framework, the Kumbh Mela of 1989 was due and presented an excellent opportunity for administering a face-to-face interview-based survey.

In 1989, the Science Communication Unit at CSIR-NISTADS (now Science Communication through Multimedia Division at CSIR-NISCAIR) initiated the first of the series of survey studies and interviewed a fairly large cross-section of the north Indian populace during the Kumbh Mela held at Allahabad. The research team, taking the opportunity of covering a large cross-section of Indian rural society interviewed about 4000 respondents.

Since then the team has administered similar surveys during Ardh Kumbh and Kumbh festivals in 1995, 2001, 2007 and 2013 to get the time series data (Table 1). Meanwhile, in 1991, with the financial support of NCSTC, a survey was also administered in the Mangolpuri area of Delhi and in 1996 a survey study was conducted on Plague related issues in Delhi and Gurgaon (Haryana).

The first study carried out during the Kumbh Mela at Allahabad in 1989 involved an open-ended questionnaire-based survey study targeted at sampling a fairly large section of the Hindi-speaking rural population of northern India. It is fair to assume that the population that visits Kumbh Mela is a predominantly Hindu religious population. However, data analysis has shown that a small percentage of local Muslims and Christians also visit the site for short durations.

Table 1 — Year, location and number of respondents for Kumbh/s and Ardh-Kumbh/s

Year	*Location*	*Kumbh/Ardh-Kumbh*	**N= No of respondents*
1989	Allahabad	Kumbh	N=3404
1995	Allahabad	Ardh-Kumbh	N=2713
2001	Allahabad	Kumbh	N=3484
2007	Allahabad	Ardh-Kumbh	N=3836
2013	Allahabad	Kumbh	N=4789

*N denotes the number of respondents for which analysis has been carried out after weeding out number of questionnaire not fulfilling the criterion. Actual number of respondents was higher than the 'N' for each survey.

During the last 25 years, it has been repeatedly argued that the thought structure of a common citizen contains two compartments, the secular and the extra-scientific. Which compartment will be invoked to arrive at decisions to act depends on specific situations that an individual is called upon to deal with. In other words, a religious or superstitious person does not always act irrationally.

The survey operation was carried out during the Kumbh Mela at Allahabad in 1989. In ten days time more than 4000 persons were interviewed. The sample included respondents who had come from almost all parts of the country. However, residents of Uttar Pradesh, Bihar, Madhya Pradesh, Orissa, Haryana, Delhi and Rajasthan figured quite prominently in the data set.

On the basis of the analysis of the data collected, it was found that those respondents who had gone through the formal education system scored fairly high on the scale of scientific awareness. And if the notion on which these explanations were presumed were introduced rather late in the education syllabus, i.e. at late school or college level, it was found that those who had undergone education merely upto primary education scored low.

As has been pointed out earlier the pilgrims who visited the Kumbh Mela had come to this place to participate in a religio-cultural event and obviously one could not expect entirely secular explanations from this spectrum of population. Nevertheless, a large number of respondents while abiding by their divine predilections did offer naturalist explanations for a number of phenomena even though they did not conform to the scientifically accepted explanation for the phenomenon concerned. Explanations of this nature were particularly offered by those who had not been tutored under the modern system of education.

Enthused by the results of the study carried out on the basis of the data collected during the above-mentioned survey, to complement, supplement and augment the conclusions arrived at, another survey was proposed. The National Council for Science & Technology Communication (NCSTC) approved the project proposal and agreed to provide financial assistance to carry out, on a fairly large populace, a survey of public understanding of science in Mangolpuri, a resettlement colony of Delhi (Raza *et al*., 1991).

The study was initiated in October 1990 and more than 16,000 respondents were interviewed, using a questionnaire containing 26 questions (in addition to the questions posed to the respondents in order to collect personal information such as age, period of residency in Delhi, educational qualification, access to communication channels, etc.). The questions were categorised in four areas of scientific knowledge – Astronomy, Geography, Health & Hygiene and Agriculture. The language used for framing the questions was spoken colloquial dialect of the region where surveys were administered.

The analysis of the data collected during the two surveys revealed that factors such as socialisation in modern system of education, the nature of occupation, the gender, age and the cultural environment of the respondents were significantly correlated with the response variable. The analysis further revealed that the percentage of those respondents who could not offer any explanation to various questions related to natural phenomena and said *Don't Know* in the urban sample when compared with the population interviewed in rural area, was substantially high. This led to the conclusion that erosion of traditional knowledge systems has taken place over a period of time and new structures of thought are yet to fill in the gap.

Furthermore, the statistical models developed for the selected areas showed a high level of sensitivity to the independent variables *cultural predisposition* and *education* on the sensitivity scale. This essentially suggests that socialisation in the modern system of education is a necessary but not a sufficient condition for inculcating deeper understanding of the scientific phenomena. The cultural modes of dissemination of information assume significant importance in the light of the above argument.

It was observed while analysing the data collected during the Mangolpuri study that since the majority of the inhabitants in resettlement colonies of Delhi had migrated from neighbouring villages about 10 to 15 years back before the survey was conducted, interaction with the metropolitan set up, change in the field of experience, and onslaught of new technologies especially those related to mass media are impinging on the coming generation thereby obliterating and toppling the traditional cultural heritage. The coming generation appears to be in a state

of transition, forgetting the old cultural traditions but yet to come to terms with the new metropolitan culture.

The factors that influenced the operant knowledgebase of the sampled population the most were access to modern educational network, occupation, gender, duration of stay in Delhi and the access to channels of information. These have a strong, statistically significant relationship with the response variable.

The following four factors operated as determinants of scientific knowledgebase of the populace:

i) the degree of complexity, counter-intuitive or mathematically obtuse explanation required to unfold the life cycle of the phenomena,

ii) the intensity with which the phenomena intervene in the life of the population,

iii) the degree of collective or individual control which the respondents could exercise in this process of intervention, and

iv) and the life cycle of the phenomenon under consideration.

The findings have not only added to the pool of general understanding in this area of research but have also helped planners and activists in deciding the policy issues for upliftment and augmentation of the knowledgebase of various sections of the society. For larger dissemination, the results of the studies were announced in journals, popular magazines and newspapers.

The two above mentioned studies also helped the team further refine its methodology during the later surveys that it administered in 1995, 2001, 2007 and 2013 to get the time series data.

Comparative demographic aspects at Kumbh and Ardh-kumbh

1. The surveys were administered at two events – the Kumbh Mela (held at 12-year intervals in Allahabad) and Ardh Kumbh Mela (held at 6-year intervening intervals). The events are marked by a conglomeration of hundreds of thousands of people gathering on the banks of the Ganges and Yamuna rivers.
2. In a period spanning 25 years, the research team conducted five surveys at the Kumbh Mela-1989, Ardh Kumbh-1995, Kumbh Mela-2001, Ardh-Kumbh-2007 and Kumbh Mela-2013 interviewing more than 20,000 respondents. After cleaning the

data this number reduced while constructing the database (see table 1).

3. The investigation involved surveys administered through open-ended questionnaires in eight areas of knowledge: "Astronomy & Cosmology", "Geography & Climate", "Agricultural Practices", "Health & Hygiene", "Biotechnology", "Environment", "HIV/AIDS", and "Perception about ghosts".

Following are some of the changing characteristics of the sampled populations over the five surveys from 1989 to 2013:

- Sampled population predominantly represented Uttar Pradesh, Madhya Pradesh and Bihar, in that order. However, people from almost all other states, to a varying degree, were interviewed during these surveys although constituted a much smaller segment of the sample.
- The average age of respondents decreased from 43 in 1989 to 35 in 2013.
- Percentage of 'illiterates' decreased from 1989 (48.8%) to 2013 (13.7%).
- Respondents with middle level education remained constant at 12%; secondary level education rose from 8.9% in 1989 to 18.5% in 2013; senior secondary or 12^{th} standard education increased from 0% in 1989 to 15.5% in 2013; graduates increased from 1.0 percent in 1989 to 21.9% in 2013; post-graduates increased from 0.4% in 1989 to 8.2 percent in 2013.
- Percentage of those engaged in agriculture decreased from 53% in 1989 to 20.7% in 2013; skilled and unskilled labour decreased from 10.8% in 1989 to 5.9% 2013; students increased from 0.4% in 1989 to 9.6% in 2013; respondents in private and government service increased from 6.6% in 1989 to 19.0% in 2013; percentage of businessmen remained constant around 10% to 12%.
- It should be noted that the literate and economically better off sections of society visiting Kumbh Mela have increased in percentage at the cost of poorer and economically weaker sections, who have increasingly found it economically difficult to visit the gatherings. Deeper analysis also showed

that expansion of literacy and education, over 25 years, across the country has also affected these percentages.

Analysis of responses from surveys from the year 1989 to 2013 reveals some significant findings:

- The percentage of those giving scientifically correct responses showed an appreciable increase from the year 1989 to 2013 for almost all areas of enquiry; consequently scientifically incorrect responses showed a decline, as did extra-scientific answers.
- Average percentage of scientifically correct responses pertaining to "Astronomy & Cosmology" went up from 32% in 1989 to 51% in 2013, a very significant increase.
  i. In 1989, 69% respondents had given correct answers to queries pertaining to shape of the earth, which went up to 81% in 2013.
  ii. In 1989, while 10.6% people answered correctly to the question pertaining to evolution of humans, this number went up to 19% in 2013.
  iii. While in 1989, 44% of the respondents could give a scientifically correct answer for a query on gravity; this number went up to 65% in 2013.
- Percentage of scientifically correct responses pertaining to "Geography & Climate" went up from 32% in 1989 to 43% in 2013.
  i. While 26% respondents knew the correct scientific explanation about earthquakes, this number increased to 48% in 2013.
  ii. While only 17% knew the correct scientific reasons for the temperature of the earth in 1989, about 58% people knew about the correct explanation in 2013.
- Percentage of scientifically correct responses pertaining to "Agriculture" went up from 52% in 1989 to 54% in 2013.
  i. About 46% respondents were aware of the importance of crop rotation in 1989; the percentage increased to 55% in 2013.

ii. In 1989, 45% respondents displayed their awareness about issues pertaining to soil conservation; in 2013 there were 57% respondents who were aware of its importance.

iii. While 63% respondents knew about green manuring, this number increased to 70% in 2013.

- In the area of "Health & Hygiene",

i. The percentage of those who answered correctly about oral rehydration therapy went up from 44% in 1989 to 51% in 2013.

ii. While 45% were aware of the scientifically correct reasons pertaining to snake bites in 1989, this number went up to 74% in 2013.

- Queries designed to elicit the environmental awareness of the respondents revealed the following:

i. 49% said that deforestation led to less rainfall and 20% related it to increase in pollution.

ii. 45% respondents could relate increase in the number of transport vehicles to air pollution rather than to water pollution (15.7%). Industries, on the other hand, caused more water pollution (52.4%) compared to air pollution (20%). Population (6.3%) increase has also been perceived by the sampled population as a cause of air pollution but population increase does not figure as the perceived cause of water pollution.

iii. 27.5% thought that industrialization causes water pollution and 16% responded that air pollution is caused by industries.

- Questioned on perceptions about nuclear energy revealed the following,

i. 27.7% respondents said that nuclear energy is a necessary evil; 16.2% said that we can generate electricity from nuclear power and 6.6% also thought that nuclear energy should be used for conducting research.

ii. Asked whether they would support establishment of a nuclear power plant in the neighbourhood, 37.3% said they would support the idea but 44.4% rejected the idea.

- Questions were also designed to check the awareness levels of the respondents about HIV/AIDS.
  i. There was considerable awareness about AIDS as 31.6% could relate the term AIDS with white blood cells (WBC) or immunity in the body; however, 31.2% expressed that AIDS means bad or impure blood in the body and 5.2 percent also believed AIDS is caused by sins committed by a person or is a curse upon people who acquire it.
  ii. While 19.4% respondents had met a person suffering from AIDS or HIV positive individual in their lifetime, which is significant number since in Indian society AIDS is perceived as a social taboo.
  iii. Regarding transmission of HIV/AIDS, 26.6% believed that AIDS can be transmitted from person to person by mosquito-bites, 6.7% believed that it could be transmitted by shaking hands, 6.9% said that sharing clothes with the patients can transmit HIV/AIDS, and 4.4% believed that hugging an AIDS patient can transmit the disease.
  iv. While 34.2% respondents said that patients can be cured fully, 39.8% responded otherwise; 9.8% were of the opinion that the patient cannot be fully cured but their life span can be increased to some extent.
  v. Relating to the social aspect of the disease, 51.6% responded that they can freely talk about HIV and AIDS among friends and family members, and 23.6% more than one in five expressed their apprehension and said that they cannot talk about it among friends and family members.
  vi. With respect to inclusion of HIV/AIDS related education in schools and colleges in the country, 71% wanted the generations to come to be educated, however, 6.5% of the respondents did not want that HIV/AIDS related education be imparted to school and college students.
- Questions designed to check the perception of respondents about the notion of ghosts elicited the following responses:

i. 67.6% said they had heard of ghosts whereas 18.9% said they had not heard of 'ghosts'.

ii. While 30% respondents revealed that they did believe in the concept of ghosts, 56% responded that they didn't.

iii. While 25% said that they had experienced such an incidence, 61% responded that they had never experienced it.

iv. 52.6% of the respondents said that there is a harmful effect of ghosts on human beings but 24.3% believed that ghosts had no effect on human beings.

- Questioned about their expectations from education, the respondents weighed in heavily with 'Employment' and 'Overall Development' as the major expectations.

i. The awareness levels pertaining to Bt cotton were not statistically significant. While 24% responded that they had heard about Bt cotton, the majority of the respondents (66.5%) said they had not heard about it.

ii. Contrary to the notion that the Indian society overwhelmingly believes that the woman is responsible for giving birth to a female child and man is responsible for a male child, the response pattern deviated from the prevalent notion where 32% held the male parent responsible for birth of male/female child and only 4% held the female parent responsible for it. However, almost 26% (one in four) believed that God determines the sex of the child.

iii. In a query designed to probe people's attitude towards changes brought about in plants and animals through biotechnological experimentation, 34% responded that scientists should conduct such experimentation on plants but 26.8 percent did not agree that such experiments should be carried out even on plants.

iv. In response to a question on abortion in case of abnormality in the unborn child, 28.8% responded that abortion is advisable in that case. However, 46.6% said that one should not go for abortion even if any deformity

or abnormality has been noticed because abortion is a sin, or thought to be against the will of 'God'.

- The following are some of the major conclusions of the report:
  i. Though one in three Indians, even in the 21st century, believes in the existence of 'Ghost', the picture is not so gloomy. During the past 25 years public understanding of science among the Indian populace has increased substantially. This increase has been largely due to reduction in percentage of people who invoked supernatural powers and believed in mythical explanations.
  ii. In the area of 'Astronomy and Cosmology' and 'Geography and Climate' the increase in public understanding of science was remarkably high in 1989– one in three citizens was aware of the scientific explanation; in 2013 this number went up to almost one in two citizens.
  iii. In the areas of 'Agriculture' and 'Health and Hygiene' the awareness levels remained high and stagnant.
  iv. Scientific yet wrong explanations also increased; however, people did not resort to invoking supernatural powers or mythical explanations, substantiating the conclusion that the population has shifted closer to scientific explanations.
  v. Across the four core areas of research among the sampled population one in five gave 'Don't Know' response since this response indicates 'cognitive gap' in the thought structure or 'lack of confidence in answering the question'. It is worrying that this percentage has hovered around 20% during the last 25 years. Extrapolation would show that this section of population is quite large and should be the focus of science communication efforts.
  vi. A substantial reduction in 'extra scientific' response indicates that despite mass media, which has made a concerted effort to spread myths and superstitions, the percentage of respondents who believe in explanations other than 'scientific' has reduced over the decades.

vii. The number of prevalent myths has also reduced.

viii. A large segment of the population does not know anything about Nuclear Power. Those who knew thought it to be a 'necessary evil'. The majority rejected the idea of construction of nuclear power plants in their neighbourhood.

ix. Deforestation is a major concern for about half the population and they believe that it has caused reduction in rainfall.

x. Despite a number of campaigns undertaken by central and state governments and civil society, awareness about ill effects of pollution has remained low during the past quarter of a century.

xi. Awareness related to AIDS/HIV has increased during the last fifty-five years; although it is still low. It is heartening that an overwhelming majority voted for unrestrained imparting of scientific knowledge about AIDS/HIV to the younger generations.

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