

## ‘Little minds dreaming big science’: are we really promoting ‘children gifted in STEM’ in India?

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‘It is not the gold in the mines, but the talents and the minds of our gifted youth which will make our country an effective participant in the global playing field.’

– Xolo<sup>1</sup>

Children ‘gifted’ in science, technology, engineering and mathematics (STEM) represent a nation’s intellectual or social capital<sup>2–5</sup>, because if identified and trained properly at an early age<sup>6,7</sup>, their extraordinary intellectual capacity can not only bring sustainable solutions for real problems in the fields of science and technology, but can make significant contribution to the nation’s economic growth and development<sup>8–10</sup>. These children demonstrate exceptional abilities for in-depth learning, enhanced capacity for abstraction and imagination. In fact, their insurmountable energy and their continuous quest for answers to difficult questions, non-typical to the general population, make them special in the classroom and society.

Earlier the term ‘giftedness’ was used as a synonym for intellectual abilities, but in contemporary education and cognitive psychology it is considered as explicit or innate potential, which if identified and nurtured allows the individual to attain extraordinary achievements or to perform at the highest level of the human capacity, in one or more areas as specifically valued within multiple cultures<sup>10</sup>. However, meanings of world views, values and achievement vary from culture to culture, and the socio-environmental milieu experienced by the individual could mediate the expression of extraordinary capacities<sup>10–13</sup>. Even to date the definition of giftedness is continuously debated and researchers in the field have not been able to arrive at a consensus in this regard<sup>14</sup>. The difference is also apparent with regard to the age at which these individuals manifest their capabilities; some express their unusual talent or the potential very early, while others are ‘late bloomers’ whose unique abilities appear much later in their life.

Although most of the developed nations conduct intensive search for children gifted in STEM and provide the

selected candidates with facilities and training to nurture the talents<sup>14</sup>, their counterparts are often neglected or overlooked in many developing countries including India<sup>1,10,14,15</sup>. The liveliness, enthusiasm and other divergences from the mainstream population of such gifted children could often make them vulnerable in many contexts; due to the lack of awareness about giftedness, their teachers count them as troublemakers in the classrooms and their parents and peers treat them as not normal, which in turn will block the full-fledged expression of their abilities or ruin the talent of such children.

In India, although the national-level initiatives like Jawahar Navodaya Vidyalaya<sup>16</sup>, National Talent Search Examination, the International Olympiads, Kishore Vaigyanik Protsahan Yojana programme, Initiative for Research and Innovation in Science (Intel-IRIS) and the INSPIRE programme have been launched to identify children possessing high-ability learning or talent in STEM, these ventures fall short of an integrated gifted education programme. Many of these programmes target children from higher grades and follow a ‘one-time measurement’ using traditional testing procedures such as examination or interview for identification. In some cases short-term training and/or scholarships are provided to the selected candidates.

However, giftedness being a developmental construct, the identification process being one of the toughest limbs of gifted education should zoom the younger age group and should be a continuous process following multi-criteria selection procedures<sup>17</sup>. A well-thought-out periodic mentoring on a long-term sustainable basis is equally important. Furthermore, vital cognitive abilities of the child such as creativity, task commitment, etc. should also be considered, along with the conventionally tested parameters (e.g. IQ, memory, problem-solving capacity). Teachers, parents and peer nominations play a crucial role in the identification process of the gifted children in STEM. Moreover, India being the culmination point of cultural and environmental

diversity and a society where a large majority of children are from rural areas experiencing severe disadvantages, including the digital divide<sup>18</sup>, only a multi-dimensional approach considering maximum number of socio-cultural determinants of giftedness while searching for outstanding performers in STEM could yield the desired result.

Against this background the National Institute of Advanced Studies (NIAS), Bengaluru, conceived, developed and implemented a Gifted Education Programme (NIAS-GEP; <http://www.prodigy.net.in/>) in 2010, with financial assistance from the Office of Principal Scientific Advisor, Government of India. NIAS-GEP identified children gifted in STEM, belonging to the age group of 3–15 years, from different parts of the nation following appropriate and state-of-the-art methodologies. In addition, NIAS has been developing material for training children and their teachers as well as to create awareness about the giftedness across the nation, in collaboration with various governmental and non-governmental agencies. This was the first of its kind attempt in India to conduct a comprehensive study of various aspects of Indian children gifted in STEM, besides creating equitable educational opportunities for them.

As a part of NIAS-GEP, an attempt was also made to understand the subjects of interest and aspirations of children shortlisted as gifted in different branches of STEM, from Karnataka. The research team interviewed 16 gifted children, comprising 12 boys and 4 girls. These children belonged to the age group of 8–14 years, and were identified following NIAS-Multistage Gifted Education Protocol. Although 16 children may appear to be a very small sample, it should be noted that children gifted in STEM comprise only a small portion of the population and our focal group has been shortlisted from school children of the entire state.

Results of the study were interesting; majority of them had mathematics, physics or chemistry as their favourite subject and more than half of the total participants

loved mathematics. One thought-provoking point noted was none of them suggested biology or any branch of biological sciences as their favourite subject. At the same time a few chose geography and economics, although their strength was science. Along with the passion for science, some of them had additional interests in music, sports (especially cricket) and the English language.

Their interest in science echoed in their choice of role models as well as their career aspirations. Many of them suggested popular figures in the field of science and technology such as C. V. Raman, A. P. J. Abdul Kalam, C. N. R. Rao, Steve Jobs and Bill Gates as their role models. The other names were Sachin Tendulkar, J. K. Rowling and Anna Hazare. About half of the total participants wished to take up professions requiring expertise in science like scientists, professors or technocrats in future; other options were civil service, pilot and cricketer. However, there were many children who were still undecided about their future plans.

Attitude of parents towards the talents shown by their child, and the importance and support given to cultivate that intellectual or creative excellence have been found to be decisive factors in the full-fledged expression of such skill<sup>19-21</sup>. In this context it is important to note that Indian parents are known for the influence they have on the educational and career decisions made by their children; hence, parents of the children who participated in the study were also interviewed. Most of the parents confessed that they never interfere in the preferences and activities of their children, no special training has been given to the children in their subjects of interest, but that they encouraged their passion by providing enough study materials. Although many parents preferred to see their children as eminent scientists in future, majority wished their kids to be 'happy and socially well-settled individuals', no matter what careers they select for themselves.

From these interviews, it seems that the parents of 'gifted children' who participated in the study are not trying to channelize the talents of their children to any specific direction, but are actively supporting the natural development of their skills, hence bringing no pressure on the developing science-lover; a positive result indeed.

According to Gladwell<sup>21</sup>, development of expertise is strongly correlated with the time spent in intense practice, and the giftedness expressed by children is not an exception to that. However, generally, gifted children with their enhanced abilities which exceed those of an average individual, desire for excellence in a wide range of subjects and activities, which often makes them uncertain about their subject choice and future careers<sup>10</sup>. In many contexts, providing enough training or proper guidance for such children may not be easy for either parents or teachers, since interests of these children may not be restricted to the curriculum.

Unfortunately, the Indian education programmes do not discuss about the inclusive education for gifted children. The absence of education programmes in the Indian school system hurts most the gifted children from under-privileged backgrounds, since they often are not identified and do not have the required resources to develop their potential. Hence, gifted children shortlisted by NIAS-GEP were linked with students from the Indian Institute of Science (IISc), Bengaluru who acted as mentors to these young, gifted children. Identification of the mentor was through a process of mutual consent that included the parents of the children who were young.

The research team at NIAS is in constant touch with the mentor-mentee group to review and assess the impact of this interaction. The purpose of this exercise is to provide a forum for the gifted children to raise questions to which they may not find the answers. The hope is that this interaction will grow and build bridges between the growing gifted children and the scientific community. This pool of 'potential mentors', mainly comprises of research scholars and postdoctoral fellows from IISc who volunteered to help these children.

Although 28% of the high-school freshers in the US exhibit a noteworthy interest in STEM, half of them (57%) lose their motivation by the time they finish their school education (<http://www.ed.gov/stem>), since 'the individual abilities of a child prodigy are malleable and have different developmental trajectories requiring different kinds of nurturing'<sup>14</sup>. In India, since a majority of the student population is from resource-poor homes and lives in villages, children

having outstanding abilities in STEM are often not able to follow their dreams and eventually lose interest in the subject area. Hence, there is a great potential for India to develop parameters and tools that are India-based for identifying the gifted children in STEM. Equally important is the need to deliberately cultivate the opportunities not only for channelizing their talents, but also to mould them as responsible citizens capable of contributing to the society. Such programmes can be effectively implemented by the science and engineering institutions of national importance, located in various states of India, incorporating support from parents, teachers, researchers and policy makers<sup>18</sup>.

Along with this, India will have to undertake intense research on identifying biological, psychological and sociological factors that make the gifted children unique from their peers. Research studies on the problems faced by the gifted children in various domains of life and coping mechanisms followed by these outstanding individuals should also be carried out immediately in order to develop an effective gifted education programme at the national level. Integrating the teachers, parents and schools is necessary for the success of the gifted education programme in India. Only then will our nation be able to harvest the benefits of the giftedness of our children in the STEM disciplines. This in turn will help us withstand the global competition since 'leadership tomorrow depends on how we educate our students today – especially in science, technology, engineering and math' (<http://www.ed.gov/stem>).

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