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Excellence in higher education and research in India

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Abstract
Human capital development is a crucial need to meet the global challenges of Indian economy by addressing the issues of education, research and employment. India has witnessed significant developments in imparting quality education and creating opportunities for specialized jobs through skill based education. There are impediments in improvement ofs educational quality and infrastructure in educational institutes to promote quality education, research and development. The Government of India through its scientific departments are supporting various schemes and projects at the scientific institutions for promoting science based specialized projects addressed to inculcate younger minds. The efforts are being made to fulfil the dream of modern India by addressing the issues of higher education, research and excellence which are highlighted in the paper.

Keywords: research, education, skill development, schemes, mentorship

Introduction
India needs to gear up with quality education for significant developments to address the problems of learning and to gain specialized job with skill development and to meet the market demand. The product coming out of secondary, higher secondary and under graduates are not getting adequately engaged in research and development activities. The focus on education is also given on elimination of shortage of manpower in science, technology, academics and industry. The emphasis is given on quality improvement in academic research and to promote dynamic and vibrant academic developments to address the critical areas especially skill development that can significantly contribute to Indian economy. It is also for formal schooling of age group between 6 to14. The implementation of Right to Education (RTE) has led to significant increase in enrolment, creation of infrastructure in school and college levels and thereby improvement of educational quality in India [1]**.** Government of India has framed the National Policy on education in 1986 and it was modified in 1992. Further, to bring dynamics in education system and quality implement with skill and knowledge, it is being reshaped. In research with the strengthening of educational infrastructure India's research output at the global position is improving.

Building Research & Development Economy
India is one of the leading nation in the world in terms of science & technology and have large pool of scientists and engineers. There has been a significant increase in the Government funding for science and technology and their exist more than 22 central funding agencies in the Government making investments for research in science and technology in the form of extra mural or sponsored projects with an aim of building research capability, infrastructure and excellence in education and research [2]. India is putting efforts on improvement of the quality of science by injecting more funds and creates new scientific institutions to fulfil the gap. The R&D investments at the global level is at 6th position in supporting funding and spending $66.5 billion estimated to be spent in 2015 [3]. Among the top global rated institutes; Indian institutes set-up of Council of Scientific and Industrial Research, Tata Institute of Fundamental Research, Raman Research Institute, Jawaharlal Nehru University and Visvabharathi University. The quality labs, better remuneration for researchers and promotional avenues are making conducive environment for research.

Need Based Skill Based Education
India can be the driving force in developing global skills-based economy. The major challenge is skill based trade for production sector in meeting acute shortage of skilled workforce that the Indian industry is facing. India has competitive advantage primarily being young population as almost half of its is below the age of 35 that need to be effectively capitalize for bringing economic returns and prosperity through execution of vocational education. In order to meet the skill development challenge Government of India has launched various schemes to promote vocational education. The focus is given on vocational education essentially refers to skills based education within the mainstream education system geared towards enabling an individual to acquire skills alongside knowledge. According to the National Knowledge Commission Report 2006-2009, India's youth severely lacks vocational training. In the 15-29 age group only two per cent have undergone any sort of formal vocational training and only about eight per cent have received non-formal vocational training. Vocational training is focusing on imparting training/skilling after formal education. Ministry of Micro, Small and Medium Enterprises (MSME) giving focus on vocational courses by introducing in mainstream school curricula across all school boards and also addressing the problems of school dropouts through skill

based education. In Indian education system vocational education is currently offered at the senior secondary level (Classes XI-XII). Most students who reach this level aspire to go for formal higher education. It is estimated that only about 3% students in classes XI and XII opt for vocational education. As the vocational education is not motivating enough for learners school education should embrace on soft skill learning with a focus on empathy, collaboration, teamwork, peer management, IT skills, communication. The focus should also be on demonstrating learning rather than vocalise knowledge ultimately for the improvement and empowerment, enabling to earn livelihood and empowerment of unemployed to help India to emerge as global skills based economy [4]

Biotechnology Education

The scheme on biotechnology education is promoted by Department of Biotechnology in joint partnership with identified Universities in M. Sc./M. Tech. The implementation of the scheme for the last three decades in biotechnology education have proven to be the best model in quality academic gain for students, teachers and researchers. The faculty is creating nucleus for research work with industry, R&D organizations. The M.Sc./M. Tech. supported in biotechnology and bioinformatics is now meeting the need of quality teaching curriculum by sharing of faculty, infrastructure through partnership approach of UGC and DBT in terms of partnership mode by sharing the faculty and infrastructure.

Crafted Courses Finishing Schools

In India the finishing school has gained popularity in offering supplementary education to the students and fulfils the deficiencies of the academic programs and curricula. The future challenges to work with industry can be addressed with existing finishing schools. Promoting the concept of finishing schools can bridge the gap between industry and academic curricula, exposing with crafted courses suitable to the industrial environment with fine-tuning. These Finishing schools are supplementary, extra-curricular specialised schools in most modern cities, teaching and training people - from youngsters to seniors. It is to empower graduate/PG students with valuable self confidence and refinements for their personal, social and business lifestyles. Initially Finishing Schools were famously located in Europe but slowly education has branched out to cities all over the world. The growing concept of finishing schools could reach to the society at large realizing the development of soft skills trainings in professional life as the perfection of education at schools and universities are required to address various other developments apart from specialize crafted courses in life sciences and business development etc.

Promotion of Star College Scheme in Science Education

At the university persuasion of R&D and innovation, knowledge dissemination helps the researchers and students in solving their problems in various research-oriented issues. The establishment of Centre of Excellence, infrastructure development creation of knowledge based centres both for basic and applied aspects. The State-of-art institute's like IITs, IISER are contributing in research innovation. The support provided for strengthening physical infrastructure in laboratories, library, teaching aids and networking with neighbouring institutes giving impetus in research based learning at the graduate level. Initiatives on creation of incubation fund in the Universities for incubation of ideas of students provides opportunities in research and education at identified institutions and create platform for companies and entrepreneurs to provide employability skills and internship to students. The scheme is supporting the development of skills of teachers by organising faculty training, improved curriculum and emphasis on practical training to students with access of specialised infrastructure and consumables. The quality education supports in life sciences and biotechnology through its 'Star College Scheme' helping colleges and university departments to impart education through to science teaching.

Sectoral Based Education

Agriculture is the biggest sector in India but for progressive growth focus is required to attract young educated people in the sector and engage them in modern technology pertaining to the agrarian sector of both food crops and cash crops. The sector is also supported by animal husbandry, a backbone of Indian agriculture. Education in veterinary and animal sciences is equally important in integrated production system especially in production system, health management and technologies related to livestock and fisheries. The livestock production improvement with genetic improvement in local breeds of the region needed for milk, meat, eggs, fish and dairy products for quality and quantity of the yield. Apart from traditional agricultural there are many more areas like sericulture, horticulture, cultivation of cash crops like medicinal and aromatic plants and various other allied areas. The challenges of agriculture need to be addressed with development of innovative agriculture technology and create opportunities for education and employment with sound agriculture courses dealing with land management, cultivation and processing of the yield with the development of production technology and secondary agriculture and ultimately outreach in marketing. Like agriculture, medical and allied biotechnology fields are growing rapidly and creating opportunities both for higher education and at the grass root level.

Farmer Based Education

Government of India under the Ministry of Agriculture and Family Welfare promotes agriculture education research and extension to help the community at large. A concept of Farmer's Field Schools have emerged as effective transfer of technology tools for promotion and popularization of eco-friendly input system for sustainable agriculture for human welfare. The first ever Farmer Field School started in 1989 in Central Java in Indonesia to reduce farmer reliance on pesticides in rice. The Farmer Field School was introduced by Food and Agriculture Organization (FAO) in an attempt to find solution. The School concept is well addressed in Karnataka introducing rural district focusing objectives to convince the farmers about the philosophy organic farming and in identification and effective management of pest and

diseases, effect on level of usage of chemicals and reduction in the cost of cultivation compared to farmer's practice. It helps farmers to significantly reduce the usage of chemicals and gain knowledge in scientific farming for better farm produce and income generation. Farmers are exposed on various agriculture technologies and help them in testing and validation of their own management conditions so as to improve adoption of technologies by the farmers. It helps farmers to gain hands-on training on various productivity enhancement technologies with primary focus on learning by doing. It includes on-farm trials and demonstration, training and exposure of farmers, field day, etc.

In India, more than 650 KVKs have been established to conduct 'On Farm Testing' (OFT) in farmers' field by identifying technologies suitable for location specific sustainable land-use systems. It conducts training programmes for farmers, rural women, youth and officers of the Department of Agriculture to make them aware about the latest technologies in agriculture. Vocational training courses on agro-based commodities like vegetable, floriculture, beekeeping, dairying, mushroom, organic farming and protective cultivation etc. are being regularly conducted for rural youth and for self-employment for farmers to update their knowledge and skills in modern agricultural technologies [5].

Women Participation in S&T Promotion

S&T sector has shown sustained growth over the years despite great challenges forming important technical workforce. They are greatly contributing to the sector in R&D and biotechnology and playing pro-active role in teaching and education and addressing the gender equality issue through adequate resource allocation and gender sensitive programme. Specific schemes for women especially in higher education are witnessing their entry in different science disciplines, including engineering, arts and humanities. Women folk both in farm based activities are engaged in cultivation and production, research and management. In agricultural extension programmes implemented by women create employment in schools, to teach agriculture at village level workers and para professionals to train the farmers. Technological advancements are helping diversifying small scale production enterprises and prioritizing career options in farm science in practical farming knowledge in agribusiness. The qualified and trained graduates are contributing to the developmental programmes /schemes for women entrepreneurship. Financial institutes viz. NABARD with the help of State Agricultural Universities encourage graduate women as partners in agri based business ventures to provide them finance from banks with university's support for the technologies, refinement and adoption. They are also involved in teaching, scientific research and extension activities from lab to field and in every sphere of S&T. Educated women are working as bio-scientist in R&D labs and pharmaceutical companies. Creation of awareness through training and counselling programmes for women teachers and trainers are widely disseminated by state S&T councils through qualified women folk.

The Department of Biotechnology is supporting Biotechnology Career Advancement and Re-orientation Programme [6] for women Scientists mainly for the career development of employed/ unemployed women Scientists as extramural research grant in the areas of Life Science and biotechnology. The scheme is also extended for unemployed women Scientists' after a career break so as to help them undertake independent R&D projects. Women participations greatly accepted in adoption of appropriate technologies and knowledge dissemination of rural technology in entrepreneurial parks/ women development centres. The Department also supports scheme to enhance the participation of Women Scientists in Biotechnology Research. The programme is targeted towards career development of employed/unemployed women scientists. The scheme open for women applicants in all areas of Life Science or Biotechnology (including agriculture, veterinary science and medicine). University Grant Commission is promoting Post Doctoral Fellowship to women to accelerate the talented instincts to carry out the advanced studies and research in various disciplines of science. The unemployed women candidates holding Ph.D. degree in their respective subject areas are eligible for the fellowships [7]. On the similar line the Department of Science & Technology is also supporting scheme to women scientists and technologists. In India, this support is very pertinent for those who have breaks in their career due to social responsibilities and are interested to return to the field of science and work [8].

The scheme is launched by the Department of Science & Technology, New Delhi through TIFAC scheme KIRAN-IPR. Women having Science and Engineering qualification are trained in the area of intellectual property rights, especially in patent searches, understanding of patent specification and preparation of technology [9]. Young women in science are encourages with scholarships to pursue scientific studies in a recognized college or university in India. PSUs like Indian Oil Corporation Limited are awarding educational scholarships to meritorious students across the country with special encouragement to girls & physically challenged [10].

To support and encourage entrepreneurship among women National Institute of Electronics and Information Technology [11], a body with the Ministry of Electronics and Information Technology has launched Saksham Power of She to promote digital India. The efforts helps students who are in the process of acquiring industry relevant skill sets in IT and electronics through interactive sessions and video conferencing and sensitizing through smart virtual classroom learning.

Launching of Special Mission

The Atal Innovation Mission (AIM) is promoted to enhance research capability to built S&T and biotechnology though industry academia programme in bio-sciences in interface with ABLE and FICCI to attract and nurture in research. AIM includes Self-Employment and Talent Utilization (SETU) with an endeavour to promote a culture of innovation and entrepreneurship by creating platform for promotion of world-class Innovation Hubs, Grand Challenges, Start-up businesses and other self-employment activities, particularly in technology driven areas. It also supports mentorship for creation of successful entrepreneurs and encourages inter-disciplinary education and training in ethics, communication and leadership with the establishment of high end research lab

for pursuing M.Sc./ Ph.D programmes and create competence in knowledge based economy [12].

Emphasis on Research & Education

In make in India movement spread across different industrial clusters in different streams of education, vocational, teacher, professional research etc. The skill based infrastructure development can enable the youth and the professionals to upgrade themselves as per the job trade and for continuing learning. India is giving great focus on skill development and working with strategic approach in a partnership mode with various Asian Countries and developed nations with the initiatives taken on skill development for creation of better youth for tomorrow for their assured placements. At present, India is facing lot of challenges in absorbing of educated youth especially in R&D institutions/ industry and private sector manpower which is not fulfilling the market demand. The graduates and the technicians produced are not well-equipped with the employers need. Thus there is need to re-orient education system to focus on skill based requirement. This is being undertaken in India through tertiary education programs at vocational schools, community colleges, technical schools, ITIs, professional schools, colleges and universities.

Leadership Development

Focused MBA programmes are required to create managers meeting the requirements of student development with well equipped programme design and curriculum framework. The basic principle involved in transformative change required for the development of capacity building and leadership in research management and institutional networking. The curriculum need to focus on action based research with series of consultations at national and state levels by bringing together the experts and field functionaries. The prime focus of National Centre for School Leadership NUEPA is transforming ordinary schools into schools of excellence and eventually bringing improvement in the entire school system through leadership development. The leading priority for NCSL therefore, is to prepare school leaders for school transformation. This would involve continuous engagement of administrators and practitioners to transform schools through collaborative effort involving stakeholders for higher education and research [13].

Mentorship Support

In S&T sector strong mentorship in identified areas need for nurturing the talent both in-house and outside India. This needs to be harnessed for which various mentorship programmes aer being supported by Govt. of India. The mentorship goal could be fulfilled by promoting schemes like Visiting Advanced Joint Research (VAJRA) Faculty Scheme promoted by Department of Science & Technology. It bring a strong international connect to the R&D ecosystem of India, offers adjunct / visiting faculty positions to overseas scientist / faculty / R&D professional including Non-resident Indians (NRI) and Overseas Citizen of India (OCI), develop high quality collaborative research in public-funded academic and research institutions of India. The faculty is engage in collaborative research in cutting edge areas of science and technology and involved in technology development, start-ups, etc. The Department of Biotechnology is also supporting visiting scientist scheme for association with Indian scientists/ faculties for the duration of 3-6 months to spend in Indian R&D labs to help the scientists in life sciences and biotechnology. The mentorship programme for qualified post doctoral through in house training by BIRAC through Biotech Ignition Grant is helpful in the similar manner. The corporate social responsibility is being fulfilled by private industry through CSIR initiatives. Also the competence has been developing in R&D in North East Region through mentorship in Biotechnology.

Scientific Schemes for Youngsters:

- **Kishor Vaigyanik Protsahan Yojana**

The Kishore Vaigyanik Protsahan Yojana (KVPY) is a fellowship in Basic Sciences promoted by the Department of Science and Technology, Government of India, to attract exceptionally highly motivated students for pursuing courses and research career in basic science. The programme identifies students with talent and aptitude for research; help them realize their academic potential and encourage them to take up research careers in science, and ensure the growth of the best scientific minds for research and development in the country. The students studying in XI standard to 1st year of any undergraduate Program in Basic Sciences namely B.Sc./B.S./B.Stat./B.Math./Int. M.Sc./M.S. in Mathematics, Physics, Chemistry and Biology having aptitude for scientific research and provide fellowships upto the pre-Ph.D. level are supported under KVPY Fellows [14]

- **Inspire**

Innovation in Science Pursuit for Inspired Research (INSPIRE) is an innovative scheme, which sponsored by the Department of Science & Technology for attracting the talent in Science. The basic objective of INSPIRE is to communicate to the youth of the country to create excitements in science and attract the talent to study science at the early age to built R&D based human resource pool for strengthening and expanding the Science & Technology system. The scheme supports generation and nurturing of a human talent pool capable of utilizing and developing first principles in science is both a pre-condition and integral part of innovation and infrastructure. The motto is to create aptitude for research and innovation at early age through attractive scholarship for Higher Education and assured career opportunity in research and development [15]

Basic Science Labs in Senior Secondary Schools (Bliss)

DBT is promoting science education programme in the North-Eastern region for imparting good science education at school level with creation of suitable platform to access modern laboratory facilities. The scheme is being supported for the establishment of "Basic Science Labs in Senior Secondary schools (BLiSS)" across the North Eastern States of India with an objective to promote education in Basic Science at Senior/Higher Secondary level and to attract brilliant students to the multidisciplinary research areas. The science lab will be a common lab for all science subjects, which includes Biology/ Biotechnology, Chemistry and Physics. The programme support covers establishment of science based lab

facilities and provision of grant for training/workshops including travel cost of experts/faculty members and also a travel support for attending short term trainings within India [16].

Addressing Brain Drain/ Brain Gain

In Indian education and research drive is needed to consider brining good brain in the country. Policy initiatives can reverse the brain drain in S&T stream and research promotion. Indians who have settled abroad in promotion of quality education and research are being given emphasis through the schemes supported by the Department of Science & Technology and Biotechnology though fellowship programmes for brilliant scientists and engineers from all over the world to take up scientific research positions in India. The fellowships are scientist-specific and support the fellows to work in any of the scientific institutions and universities in the country and they would be eligible for receiving regular research grants through the extramural funding schemes of various S&T agencies of the Government of India. Scientists and engineers of Indian origin from all over the world are encouraged to take up scientific research position in Indian Labs through schemes like Ramanujan and Ramalingaswamy Fellowships [17]. Similar scheme also exists in the area of biotechnology. The Ramalingaswamy Re-entry Fellowship for biotechnologists to provide attractive avenues to pursue R&D in Indian institutions is being supported by the Department of Biotechnology. Also in partnership with Wellcome Trust (WT) a global charitable foundation is jointly working with DBT and supporting the brightest minds, the fellowships to Indians working outside of India and within India and also open to non-Indians willing to work in India in their early career, senior fellowships [18].

Science, Technology and Innovation Policy

For developing countries like India, Research and Information System (RIS) are actively engaged in the discussions and discourses around the issue of access, equity and inclusion in science, technology and innovation, both at national and the global level. It addresses science policy framework seeking the alignment of technological innovation with social values and supports the goals for meaningful development. The responsible S&T need promotion to produce ethically acceptable, sustainable and socially desirable research and innovation outcomes to facilitate the developments of socially relevant areas. RRI is also partner institute in implementation of New Horizon Policy-2020 and aims to explore the excellence in science and innovation by adopting the concept of Responsible Research and Innovation. The Government is creating a space for women development also to enable them to realize their full potential, equal access for their participation in decision making of women in social, political, economic and S&T development activities of the nation.

To strengthen the education sector the following strategic solution suggested

1. Introduction of Refresher courses and seminars provide opportunities to the faculty to update with latest concepts, strengthen their teaching base with innovative teaching methods.
2. Open career option incentive schemes for bringing talented teaching, mentoring teachers need by rewarding them and allowing to share with their experience for exchange of knowledge and ideas in social entrepreneurship development among the youth.
3. The establishment of Centre of Excellence at State University for promoting research in academics and applying knowledge useful to youth researchers with upgradation of research facilities to inculcate research ideas for discovery driven research.
4. Introduction of choice based credit system and assessment has been a welcome step at secondary education and to meet with the International standard, the University Grants Commission has come up with the Choice Based Credit System (CBCS) programme. This will provide opportunity to the students to have a choice to choose from the prescribed courses, which are referred as core, elective or minor or soft skill courses. The students can learn at their own pace and the entire assessment is graded-based and on a credit system. The basic idea is to look into the needs of the students so as to keep up-to-date with development of higher education in India and abroad
5. The student's assessment cannot be totally based on the report card, but it needs to be of interactive mode by introducing methods of teaching and learning. In conventional educational system, presently the performances of the students are reported on the basis of marks secured in the examinations or grades or both to introduce uniform grading system in education system.
6. In education system, information and communication technology is a powerful information dissemination system available for enhancement of skills for many other end-users. But it has not been suitably adopted in the education sector. There is immense scope for harnessing ICT to improve quality of teacher preparation, provide aid to teachers in classrooms, take remedial coaching that need to be seriously looked into. There is need to harness 'Big Data' to track student-learning tools to assess teacher's quality, track the progress of individual schools.

Epilogue

Today is the era of education, research, innovation and excellence. India needs to promote world class research with higher budget for research and development. Creation of infrastructure would boost science education focusing on technology and reduction in income and gender disparities. Measures in fostering scientific temper in designing and innovative programmes are giving weightage. India got huge opportunity for skill improvement and knowledge upgradation at primary and higher education level. Youth particularly need to improve skill and excel in their professional and self employment carrier. The rise in educational and technological capabilities may bring many more avenues for potential researchers. The establishment of state-of-art labs and research centres in India, researchers and scientists and make them to have a way forward to develop good quality education programme. This would help to create large proportion of people absorbed through specialized skilled development as a ladder and through the vocational education at secondary level

schooling with well-equipped for training to meet the vibrant economy of India.

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