

# Role of Research and Innovation in Higher Education

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## Abstract

Research and innovation in higher education strengthens technological advancements, encourages economic growth, spearheads advancement of societies, strives for job creation, and provide students with proficiencies to play leading role in the overall development of institutions as well as the individual students.

## Ancient Indian Contribution to Research and Innovations

Indian sub-continent has always been a cradle for novel research and innovations. Variety of languages and schools of thoughts in the form of enriched Vedic, philosophic, Ayurvedic, mathematical, medicinal explorations may be cited as proud indigenous possessions.

- Rules were systematized to develop Sanskrit Grammar, called *Ashtadhyayi*.
- The 'notation system', the 'decimal system' and the 'use of zero' were the three distinct contributions of ancient Indian scholars. The 'decimal system' could be found in the inscriptions of Ashoka. The zero was used as a separate numeral by Indian mathematicians. Knowledge of measurement and geography is reflected from the brick constructions of Harappa.
- Practical geometry of Apastamba described acute, obtuse and right angles. Method of calculating the area of triangle was formulated by Aryabhata. Aryabhata and

Varahamihir analysed the position of position of planets and discovered the cause of lunar and solar eclipses and also measured the circumference of the earth, asserting that the earth is round, rotates on its axis and revolves around the Sun. The study of astronomy was promoted not only to study the planet movements, but also study the changes in seasons and weather conditions for agricultural activities. Aryabhata laid the foundations of future development of trigonometry, measurement of shapes and sizes of plots, assessment of rent and taxes and erection of temples and palaces.

- Centuries before John Dalton, Kanad ventured into the existence of *anu* or a small imperishable particles like an atom.
- Tamils of Chera Dynasty produced the finest steel. Zawar in the Tiri valley of Rajasthan is known for zinc melting site.
- Renowned text on ancient surgery, Sushruta *Samhita* offered details of various illnesses, plants, preparations and cures along with complex techniques of surgery, including plastic surgery and cataract surgery.

- *Charakasamhita*, a celebrated text on the ancient science of Ayurveda, offered the concept of digestion, metabolism and immunity as well as a manual on preventive medicine.
- Archaeological excavations and evidences – of the Indus Valley Civilization, settlement of Dholavira, Kautilya's *Arthashastra*, Kallanai of Chola King Karikal across the river Cauvery, artificial lake built by King Bhoja of Bhopal, bamboo-drip-irrigation used by the farmers of Khasi and Jaintia hills in the Northeast – all demonstrate the techniques of water harvesting, drainage and conservation.
- Kautilya's *Arthashastra*, dealing with the means of acquiring and maintaining the earth, presented the science of acquisition, preservation, accentuation and bestowal of the surplus upon the deservers, striving for well-being or *yogakshema* of livelihood on earth.

No doubt, Indians, since ancient times, have contributed immensely to research and innovations. Just a figurative depiction accolades reflect that innovation system must have a close connection with society, government, non-government, livelihood sustenance and existence.

### Research and Innovations in Contemporary Times:

The ongoing research, while concurring with pressures from contemporary society; must complement and supplement the supply of and demand for development and implementation of various innovative practices. Successful innovative practices rely upon various factors like, scope of initiative, level of autonomy, influence of national/regional and institutional factors, allocation of resources etc. A study (John Brennan, Steve Ryan, Marina Ranga,

Simon Broek, Niccolo Durazzi, & Bregtje Kamphuis, (2014), "Study on innovation in higher education: final report", available at <http://eprints.lse.ac.uk/55819/>) conducted by London School of Economics on "Innovation in Higher Education" has concluded by saying that autonomous higher education institutions having more control over their financial resources and allocation of these resources to their functions, tend to develop more **bottom-up practices**. The direct impact of these types of innovations may be more immediate, but also more limited, often confined to the boundaries of the innovating institution. On the other hand, less autonomous higher education institutions tend to have a more **top-down, state-driven approach** to innovation. This does not make them less innovative, but comes to support wider-ranging relationships and processes across the higher education system and longer timescales for implementation, ensuring a longer-term and larger impact beyond institutional boundaries.

The development and implementation of innovations in higher education systems have three dynamics:

- a. As innovation diffuses within the higher education system and touches every element of a higher education institution, the innovation process needs to be better managed. While management methodologies are taught in many universities, university managers are not trained for this, and in most cases they are promoted academics;
- b. There is a reciprocal nature of change within an innovative higher education system. The development and implementation of innovations in higher education systems have an impact on all the systems elements: components, relationships and functions. *At the components level*, a wide range of direct and

indirect, individual and institutional actors are influenced by these innovations. *At the relationships level*, the most important effects are due to cooperation, networking and increased mobility, which may alter traditional relationships among actors or introduce new ones. *At the functions level*, the most significant impact is observed on the education function, and a more limited, but growing impact is observed on the research and engagement functions. The system elements (components, relationships and functions) have an impact on the success of the innovation, while the success of the innovation induces further changes in the system elements. A spiral of change is, thus, created within the higher education system to make it more responsive to environmental changes;

- c. The change induced in a higher education innovation system by the innovative practices examined in the study is not of a radical nature, but is rather slow and incremental. Many innovation practices do not radically modify the traditional Higher education institutions' functions; rather, they provide new ways of doing traditional things that respond more efficiently to changing requirements in higher education.

### Research Initiatives in Kalindi College

While maintaining a balance between teaching and research and emphasizing multidisciplinary learning and research, Kalindi College, a constituent college of the University of Delhi is promoting research at under-graduate level by yearly allocating some seed money to research projects involving faculty and students. While following the University approved syllabus in all disciplines, faculty and students are encouraged in sciences (Botany, Chemistry, Computer Science, Mathematics, Physics and Zoology), Commerce, Humanities (English, Hindi and

Sanskrit) and Social Sciences (Economics, Geography, History, Journalism, Political Science) to gain sufficient breadth and depth in their respective disciplines or multidisciplinary learning.

**During 2017-18**, 22 Research Projects were allocated to 13 different departments. Areas covered during the year included: Quality Assessment of Drinking Water at Inlet and outlet of RO System in Kalindi College; Result Analysis Suite & Feedback System; Social Media for Youth; Portfolio Optimization with Emphasis on Investments Made by Indian Women; Numerical Analysis & Quantitative Analysis; Group Theory; History of Indian Mathematics; Metal Contamination in Environmental Samples; Mode of Excitation in Optical Waveguides; Living Green Wall of College; Motivational Level of Industry Workers; GIS Based Emergency Response System of Kalindi College; *Vigyapanon Ka Samajik Sandarbh*; Interplay with Architectures of Mamluqat-i-Sultanate-i-Hind with special reference to Qutub Complex; Prayas: An Initiative to Ban Plastic & Promote Pottery Heritage; Thumri Gayaki-Development; Right to Privacy is a Fundamental Right; Urban Marginality: Emerging Problems of Northeastern Girl Students; Empower Women, Empower Nation; Dalit Women Elected in Local Governance; Sanitary Napkins: its accessibility, acceptability and sustainability in areas of Delhi and Haryana; and Economic Transition and Obesity in Adolescence Children.

**In 2018-19**, total 45 Research Projects were allocated. 36 projects were Discipline Centred covering: Environmental Awareness in Micro and Small Enterprises (Services) of Karol Bagh Commercial Area; Women Entrepreneurship; Financial Literacy: A Study of University of Delhi; Economics of Happiness; Gender Wage

Differentials; Structural Reforms and Health Equity; masculinization through the genre of the bildungsroman; politics of banning of a tribal (Santhal) Text; Young Emotions; Non-Heteronormative Experiences; Women in the Adapted Versions of Marchen; Empowering Women in Delhi/Urban Slums through digital literacy; Health Care Management Information System; Impact of Pollution on Historical Monuments; *Sufi Sangeet Evam Sahitya*; Political Participation of Dalit Women; Accessibility of Right to Information Act 2005; Women's Health and Nutrition; Process Management of Plastic Products; Mathematica Modelling of Air Pollutants; Subject Assignment Using Mathematical Programming; Green Synthesis of Gold Nanoparticles from Leaf Extract of *Rhoeo Discolor* and Study its Antimicrobial Properties; Documentation and Identification of Pollens Found in Kalindi College; Educational Exposition of Bottle Vertical Garden System; Urban Green Spaces with potential Carbon Stock; Reinvigorate the Butterfly Conservatory; Analysing Real World Relationships through Network Analysis; Online Transaction Security Issues in MANET; Fresnel's equations for reflection of electromagnetic waves; Optical Characterization of Semiconductor based Light Sources and their Applications; Investigation of Adulteration in Milk using Surface Plasmon Resonance; Research Methodology for Physics Research; Empowering EWS Students of Kalindi College through Screen Printing Literacy; and Placement Portal Kalindi College.

09 projects were of inter-disciplinary nature covering wide range of subjects including Sustainable Waste Management Practices in Higher Educational Institutes, Impact of GST on Commerce and Industry, Cinematic Representation of Women in Popular Period Films of Bollywood, History of Education System in India, Employing Mathematical Methods and Techniques for Solution of

Problems in Physics, Vedic Mathematics, Modeling for the Future Flood Vulnerability and Risk Assessment Analysis, Ayurveda: The Alternative System of Time Tested Medicine, and Strategy for Students Success through Medical Diagnostics

During the current academic year 2019-20, total 20 Discipline centred as well as 08 inter-disciplinary Research Projects have been allocated. Discipline centred research comprehended Applications of Data Analysis in Education; Synthesis of ZnO Nanomaterial by Precipitation Method and Characterization for Photocatalytic degradation of Contaminants in water; Mechanics Problems through Computer Simulation using Scilab; Electrical behavior of Metal-Semiconductor Contacts for UV Photodetectors; techniques for accelerator based experiments; Carbon Nanotube (CNT) based gas sensors; Metamaterial based Waveguides; Reinvigorate the Butterfly Conservatory; Linking urban green spaces with potential carbon stock; Impact of Mudra Yojna on Employment in Delhi; Experiments in Economics: An analysis of Theory and Evidence; Rationing Constraints in Indian Rural Credit Market and Farmer Suicides; Gender Stereotypes across Different Cultures; The Third Gender: Breaking Stereotypes and Exploring Opportunities for the Transgender Communities in Delhi; Mathematical Modeling of Natural Resources and its Impacts on Future Population Growth in India; Differential Equations used in daily life; Applications of Cryptography; Women's Political Participation and Decision -Making Power in Northeast India; Empowering Dalit Women Elected Representatives (DWERS) in Local Governance; and *Kalidas ke Sahitya Main Samajik Jeevan ka Yatharth Chitran*;

The inter-disciplinary projects are covering wide range of subjects like: Scientific solution

of manual scavenging; Electrogenic Microbes in Energy Production from Waste Water; Web-based Interactive Virtual Laboratory System; e-content development for undergraduate students; *Madhyakaleen Bhartiya Sahitya main Stri Rachnakaaron ke yogdaan*

External experts have been invited for monitoring and accountability of and transparency in research projects. Faculty has been encouraged to search for sponsors and funding for better quality research in the college. The objective of this ongoing undergraduate research is to augment academic research, actionable programme, extension and community outreach activities and outline a roadmap for future innovations.

### Outcomes and blockages

Four main outcomes of innovation in higher education emerge:

- (i) the vision behind and the use of new technologies represent enablers of innovative practices, rather than innovations per se;
- (ii) the use of new technologies appears to be a facilitator of the transition from a department-centred vision to a student-centred vision of education;
- (iii) innovation often stimulates an accelerated development of partnerships between Higher education institutions and other organisations, especially businesses;
- (iv) innovations in higher education illustrate well two general key aspects of the innovation process: 'doing new things' and 'doing existing things better'.

The blockages for innovation can be found both at the institutional-level, such as the paucity of funds, and lack of institutional support for innovative practices and at national/regional, for example influenced by different degrees of autonomy of higher education institutions. Regulatory frameworks and limitations of

availability of infrastructure are also a crucial potential blockage to some innovative practices.

Notwithstanding these blockages, innovative practices do show the potential for delivering high-quality and equitable outcomes, in terms of widening access to higher education, granting students a more central role within the system, and providing potential pathways to cope with the financial pressures that affect the system.

### Policy recommendations related to the changing landscape of teaching and learning in higher education

Higher education institutions should consider the need to:

- Nurture an institutional culture to innovation that enhances creativity, creates awareness of the benefits resulting from the implementation of the innovation, stimulates openness to innovation and minimises resistance to change
- Consider incentives and rewards for members of staff (including but not limited to academics) who engage in innovative practices
- Engage faculty members in exploiting the potential of new learning technologies
- Consider the use of cross-institutional collaboration to improve student choice and quality (and possibly cut costs)
- Put in place adequate measures for skills development of teaching staff and also for greater collaboration in performing their teaching duties
- Review existing organisational boundaries and linkages

Our contemporary practices promote research mainly in research institutions. Contrary to most acclaimed universities of the West, most of Indian universities have remained

indifferent from innovations and research and relegated this area to small research groups of research courses/degrees. The need of the hour is to encourage inquiry-based, research-based, field-study/case-study based under-graduate and graduate education programs. Collaborations at institution, university, state, national and international level have be promoted. For the purpose, advanced centralized facilities may be encouraged in the university departments and colleges, while adapting to the change, widening the horizon of education to include artificial intelligence, bioscience, food innovation, envisioned environment, to name a few; and thereby preparing students for the challenges of tomorrow.