ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

Replicating the Success of the American Research Ecosystem Everywhere: Towards Quantum Advancements of Science in the Developing World

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Publication Date: 2026/01/23

Abstract: The objective of this paper is to explain and enumerate why we need to replicate the success of the American research ecosystem everywhere, and to explain why doing so could lead to quantum advancements in science everywhere, particularly in the developing world. We begin this paper by reviewing the history of education systems worldwide, and then proceed to define vital terms such as a university and a research university. We also briefly trace the history of the American university, and briefly probe and investigate the American university system, the American research ecosystem, and American research funding models. We also briefly discuss research, the different types of research, and the different types of research funding models worldwide. As a part of this exercise, the different types of research grants including research fellowships are probed and investigated. Other aspects such as research scholarships, corporate funded and corporate sponsored research, industry academia collaboration, research outsourcing, research contracts, and research as a service are also reviewed. A large number of recommendations are also proposed as a part of this paper, and these would as such constitute the core essence and meat of this paper. We do therefore, hope, expect and anticipate that this paper would become a vital one in our overall globalization of science mission and objectives.

How to Cite: Sujay Rao Mandavilli (2026) Replicating the Success of the American Research Ecosystem Everywhere: Towards Quantum Advancements of Science in the Developing World. *International Journal of Innovative Science and Research Technology*, 11(1), 1702-1710. https://doi.org/10.38124/ijisrt/26jan787

I. INTRODUCTION

The objective of this paper is to explain and enumerate why we need to replicate the success of the American research ecosystem everywhere, and to explain why doing so could lead to quantum advancements in science everywhere, particularly in the developing world. We begin this paper by reviewing the history of education systems worldwide, and then proceed to define vital terms such as a university and a research university. We also briefly trace the history of the American university, and briefly probe and investigate the American university system, the American research ecosystem, and American research funding models. We also briefly discuss research, the different types of research, and the different types of research funding models worldwide. As a part of this exercise, the different types of research grants including research fellowships are probed and investigated. Other aspects such as research scholarships, corporate funded and corporate sponsored research, industry academia collaboration, research outsourcing, research contracts, and research as a service are also reviewed. A large number of recommendations are also proposed as a part of this paper, and these would as such constitute the core essence and meat of this paper. We do therefore, hope, expect and anticipate that this paper would become a vital one in our overall globalization of science mission and objectives.

Education in Ancient Egypt was generally based on class, and formal schooling was provided mostly for boys from elite backgrounds. Education in ancient Egypt was generally focused on scribal arts (reading, writing or drawing hieroglyphs, and elementary mathematics) and was provided by temple schools or government schools. Educated people, who comprised a very small percentage of the population, were absorbed in prestigious roles such as priests, doctors, surgeons, government officials, and respected, while on the other hand, most common boys learned trades through a process of apprenticeship, with girls being taught domestic skills to become efficient homemakers. Education in ancient Mesopotamia, centered around temple schools which were called edubbas, and these trained elite boys drawn from a small group of privileged individuals to become scribes who well-versed in cuneiform writing, arithmetic, and administrative tasks, thereby preparing them for state, temple, or commercial roles; as a part of their education, which was only imparted to a small number of people, subjects such as history, law, medicine, science and astronomy, were taught along with rote memorization. Girls on the other hand, learnt domestic chores at home. Other countries observed and followed different systems; for example, ancient Chinese education

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

was heavily influenced by Confucianism with Confucian classics being taught. [1] [2] [3] [4]

Education in Ancient Greece tended to varied widely from city-state city-state; with Athens emphasizing well-rounded citizenship known as paideia with an emphasis based on academic knowledge, while Sparta focused solely on military discipline from a young age. Education was mostly meant for boys, though many girls were educated as well. In ancient India Takshashila and Nalanda were eminent centres of higher learning. Later, other centres such as Valabi, Vikramashila, Pushpagiri, and Somapura were established. However, the modern education system is traced to Medieval Europe, even before the renaissance and the enlightenment took place. Examples of early universities in Europe included the University of Bologna which was established in 1088, the university of Oxford, which was established soon after, in 1096. Other early European universities have included the university of Paris, the university of Bologna, the university of Cambridge, the university of Padua, the university of Coimbra, the university of Perugia, and the university of Salamanca. Interestingly, the university of Al-Qarawiyyin (based out of Morocco, and established in the ninth century anno domini) is recognized by Guinness World Records as being the oldest existing, and continually operating educational institution in the world, This originated as a religious institution before evolving into a university. [5] [6] [7] [8]

[1] Feingold, M. (1991). Tradition vs novelty: universities and scientific societies in the early modern period. In P. Barker & R. Ariew (Eds.), Revolution and continuity: essays in the history and philosophy of early modern science, Studies in philosophy and the history of philosophy. Washington, D.C.: Catholic University of America Press, pp. 46-50

[2] Gascoigne, J. (1990). A reappraisal of the role of the universities in the Scientific Revolution. In D. C. Lindberg & R. S. Westman (Eds.), Reappraisals of the Scientific Revolution, pp. 245-248

[3] Gascoigne, J. (1990). A reappraisal of the role of the universities in the Scientific Revolution. In D. C. Lindberg & R. S. Westman (Eds.), Reappraisals of the Scientific Revolution, pp. 210-229

[4] Westman, R. S. (1975). "The Melanchthon circle:, rheticus, and the Wittenberg interpretation of the Copernicantheory". *Isis*. **66** (2): 164–193

[5] Verger, Jacques: "Patterns", in: Ridder-Symoens, Hilde de (ed.): *A History of the University in Europe. Vol. I: Universities in the Middle Ages*, Cambridge University Press, 2003

[6] Riché, Pierre (1978). *Education and Culture in the Barbarian West: From the Sixth through the Eighth Century*. Columbia: University of South Carolina Press. pp. 126–127, 282–298

[7] Delle Donne, Fulvio (2010). *Storia dello Studium di Napoli in età sveva* (in Italian). Mario Adda Editore. pp. 9–10

[8] Maggie Berg & Barbara Seeber. The Slow Professor: Challenging the Culture of Speed in the Academy, p. x. Toronto: Toronto University Press. 2016

➢ *What is a University?*

A university may be defined as a very large and prominent institution of higher education and research that offers graduate, post-graduate and doctorate courses, and confers academic degrees (bachelor's, master's, and doctorate degrees for example) across a wide variety of subjects, providing extensive research facilities, and a diverse, immersive and dynamic learning experience for both undergraduate and postgraduate studies, unlike smaller colleges that are mostly focused on a smaller number of platforms, and do not generally offer research courses. Universities are also mostly involved in the knowledge creation process and intellectual development of students (at least where research courses are offered), and the term "university" itself is thought to be derived from a Latin term "universitas magistrorum et scholarium*"* which means "community of teachers and scholars", and from later medieval "studia generalia" which were medieval precursors of modern universities. British philosopher David Walter Hamlyn of the University of London perceives universities to be institutions involved in the knowledge production process and the training of future researchers as well while John Henry Newman sees universities as a cultural force for good. Wilhelm von Humboldt wanted to combine research and teaching, and he thereby created the Humboldtian model of higher education which was known as "Humboldtsches Bildungsideal" in German. Types of universities include public or state universities which are funded partly or fully by various national governments, private universities that are established and funded by private entities, deemed universities or deemed to be universities which are meritorious institutes given university status by governments, and open universities, which offer education through the distance mode. [9] [10] [11]

➢ *What is a Research University?*

A research university which is also sometimes referred to as a research-intensive university is a university that carries out research as a core, central and intrinsic part of its mission. Research universities may therefore be defined important or primary sites of the knowledge production process and scientific productivity by focusing on pure and applied research. They are also most of involved in the "intergenerational knowledge transfer and the certification of new knowledge", and the systematization and regularization of new knowledge. This may be done through the awarding of doctoral degrees, and the constitution of research programs. Research scholars may be invited from all over the world to participate in research programs, and make groundbreaking discoveries. This kind

[9] Barrow, Clyde W. (1990). *Universities and the Capitalist State: Corporate Liberalism and the Reconstruction of American Higher Education, 1894–1928*. Madison, Wis: University of Wisconsin Press

[10] Pedersen, Olaf (1997). *The First Universities: Studium Generale and the Origins of University Education in Europe*. Cambridge: Cambridge Univ. Press

[11] Segre, Michael (2015). *Higher Education and the Growth of Knowledge: A Historical Outline of Aims and Tensions*. New York: Routledge

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

of universities first arose some two or more centuries ago in Germany, where the unity of research and teaching was championed in fields such as mathematics, natural sciences, social sciences, and the humanities. According to Roger L. Geiger, who specializes in the history of American research universities, the model for the American research university was established by five of the nine colonial colleges that were chartered before the occurrence of the American Revolution (namely Harvard, Princeton, Yale, Columbia, and Pennsylvania); five state universities (Michigan, Minnesota, Wisconsin, Illinois, and California); and five private institutions conceived from their inception as research universities (MIT, Johns Hopkins, Cornell, Stanford, and Chicago). The American research university may therefore be said to have first emerged in the late nineteenth century, when these fifteen institutions first began to graft graduate programs derived from both German models and other research models. Such universities were often associated with American power and hegemony, and served as role models for the rest of the world as well. They were also seen as torchbearers of social progress and modernity.

Such universities may be public universities and affiliated to government bodies; in some cases they may be private or set up through public-private ventures and partnerships too. Other graduate and post-graduate courses may also be provided by such universities, though these may mostly be provided only as an afterthought. Post-doctoral programs may be provided too. The nature, composition and content of such courses may also vary, and scientific method and creative thinking may mostly be taught. The faculty members of such universities are also often pressurized to publish papers in research journals, and as such, they need to be well-versed in both teaching and research. Of late, several nations of the Middle East have attempted to mimic and emulate the American model, and China and India are making giant strides too. Some of China's top research universities are Zhejiang University, Tsinghua University, Peking University, and Shanghai Jiao Tong University, etc. Other important research hubs in China are the Chinese Academy of Sciences and the University of Chinese Academy of Sciences to name a few. Top research universities in India can be said to include the Indian Institutes of Science (known as IISc in short) and Technology (known as IITs in short, with branches in Delhi, Bombay, Madras, Kanpur and Kharagpur) alongside other institutions such as the Tata Institute of Fundamental Research (TIFR) and the University of Delhi. Research in private universities continues to be minimal, and the number of private universities in India continues to be minimal too. [12] [13]

II. HISTORY OF AMERICAN UNIVERSITIES

The entire continent of North America, which forms a part of the new or newly discovered world, was discovered by the intrepid voyager Christopher Columbus who set sail from the old world in the year 1492. Since then, the United States of America, which occupies a significant part of North America, has made gigantic leaps in many fields of sciences, endeavour and scholarly inquiry, and has emerged as a scientific, intellectual and technological power to boot. It has also emerged as a role model and a beacon of hope for the rest of the world. The history of higher education in the United States began in the middle of the seventeenth century and has made gigantic leaps and strides in most spheres and fields of academic endeavour and inquiry right up to the present time. American higher education is now known throughout the world for its rapid and unparalleled expansion, and stellar achievements and accomplishments. The American education system was first significantly influenced by British model of education in the colonial era, and German model of education in the nineteenth century, both of which provided its parental role models. The American education system is initially first thought to have begin with the establishment of a couple of religious establishments and government schools. Harvard College, which is now known as Harvard University, was founded by the Massachusetts Bay colonial legislature in 1636, and is now one of the pre-eminent universities in the world. The College of William and Mary was founded by the Virginia government in 1693, and it conducted research on vital areas including business, law, education, and the general arts. Yale College which is now known as Yale University, was founded in 1701, and later relocated to New Haven, Connecticut. Princeton University, initially known as the college of New Jersey, was founded in 1747. [14] [15] [16]

The Columbia University began in the year 1896, with antecedents dating back to 1784 as the Columbia College. The Brown University, formerly known as the Rhode Island College, was founded in 1804. The University of Pennsylvania was founded in 1791, though it has roots going back to 1749. The Rutgers University was founded in 1766, and the University of Delaware was founded in 1743. We must also mention the Ivy League in this context; the Ivy League refers to eight prestigious private universities located in the northeastern part of the USA known for a high degree of academic excellence, and impressive history. The name itself is attributed to “planting the Ivy tradition” which was common in the 1800’s. These universities are indeed among the prestigious universities in the world: These universities include Brown University, Columbia

[12] David Weerts, *State Governments and Research Universities: A Framework for a Renewed Partnership*. New York: Routledge, 2002, p. 26

[13] Colleges Will Co-operate: Organization of the Association of American Universities". *The Washington Post*. March 1, 1900. p. 2

[14] Apaydin, Marina, et al., editors. The Internationalization of Higher Education : Concepts, Cases, and Challenges. Information Age Publishing, Inc., 2023

[15] Aronowitz, Stanley. *The Knowledge Factory: Dismantling the Corporate University and Creating True Higher Learning*, p. 76

[16] *Bousquet, Marc (2008). How the University Works: HigherEducation and Low Wage Labor (1st ed.). New York: New York University Pressa*

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

University, Cornell University, Dartmouth University, Harvard University, Princeton University, University of Pennsylvania, and Yale University. The term is relatively recent, though the universities themselves are much older indeed, and most of them were founded during the colonial period. [17]

➢ *An Overview of the American University System*

The American university system may be viewed as a highly diverse and decentralized system of education, with nearly four thousand accredited institutions of different types such as community colleges, (with affordable tuition fees, and prime examples being Broward College, Miami-Dade College, and Maricopa Community Colleges) state universities, private colleges, and research universities for doctoral and post doctoral programs and degrees. This diversity is one of the strengths of the American education system as observed by Nicholas Hillman, and others. Key characteristics of the American education system, include autonomy and decentralization with minimal federal or state government control. However, education systems in the USA are generally based on several key parameters and outcomes. State government and sometimes the federal government provide a broad direction to the functioning of universities, and provide some level and degree of oversight as well. Some types of funding models such as performance-based funding models are often employed by state governments. Often, articulation and co-ordination programs are provided by many American states. In addition, there are four regional education compacts in the USA that are constituted for policy analysis and research such as the Midwestern higher education compact, the New England board of higher education, the southern regional education board, and the western interstate commission for higher education. They also seek to improve quality of education, and access to education from time to time. In 2025, the Federal government proposed the "Compact for Academic Excellence in Higher Education" to link federal funding access for universities based on ideological and policy mandates. In addition, there is a “Campus Compact” which is a coalition of universities committed to fulfilling the general objectives of the higher education system. This was founded by Howard Swearer, Donald Kennedy, and Timothy S. Healy in 1985. The “Carnegie classification of institutions of higher education”, also known as the Carnegie Classification, was created in 1970 by the Carnegie Foundation for the advancement of teaching, and helps classify colleges and universities in the United States, and provides a template and blueprint for research too. [18]

➢ *How American Universities are Funded*

American universities are generally funded through a complex and a diverse mix of tuition fees, state and federal government money that is provided in the form of grants (this is provided especially for research and other specialized purposes), donations from wealthy private individuals, corporate universities, businesses and parents in the form of philanthropy and charity, endowment (this is a financial gift provided to a university often for the constitution of a corpus or other purposes), etc. State funding and state sponsoring or patronage is often crucial for many public universities, and is often used to bear operational expenses as well, while different types of federal grants are important for STEM research and other fields. There may be political interference in this process leading to cutbacks on research or increased reliance on tuition and philanthropy leaving institutions weak on account of volatility and instability of income. Other auxiliary sources of income also exist, though such income streams are often weak and irregular. Financial aid for American university students comes in the form of federal, state, institutional, and private sources, through loans, grants and scholarships. and it covers many different types of costs such as tuition, housing, accommodation, and books. Students also often work part time to pay for their tuition fees. Scholarships for American university students may come from various sources including universities themselves which offer them based on merit or need, US government programs such as Fulbright scholarships, (this is an international exchange program) Pickering scholarships (offered by the US government for foreign service careers) or Udall undergraduate scholarships provided to students with committed to specific causes such as the environment and the native American culture. Private foundations such as Inlaks, PEO, Tata for Cornell, AAUW for women also provide scholarships to deserving and meritorious students. Educational loans in the USA. comprise federal and private categories with private lenders such as MPOWER, Sofi, Prodigy Finance, Ascent, Sallie Mae being major players. [19] [20]

➢ *What is Research?*

The English word “research” is derived from the French term “rechercher” which means to search, and the latter word is in use since at least the sixteenth century. Research may be defined as a systematic, and a highly creative investigation that is carried out in order to discover new forms of knowledge, and add to the existing body of knowledge. The entire process of research may be broken down into a series of sequential steps, and examples of activities constituting research may include collecting and analyzing data in order to systematize observations, solve complex or intractable problems, or understand wide-ranging phenomena, in different fields of sciences. Research must be structured, systematic and objective, and researchers must always guard against biases, prejudices and errors. Research may be categorized into basic research and

[17] Engwall, Lars, editor. Internationalization in Higher Education and Research : Perspectives, Obstacles, Alternatives. Springer, 2023

[18] Diti Kohli; Brooke Hauser; Hilary Burns (October 4, 2025). "Trump makes MIT an offer, one many on campus hope the school can refuse"

[19] *University Business*, "Preparing for the Net Price Calculator: Avoid Potential Pitfalls by Taking These Steps Today," Haley Chitty, October 2009

[20] *Challenges and Opportunities: Meeting the Federal Net Price Calculator Mandate* by David Childress, Bill Smith, and Marc Alexander, May 2010

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

applied research; in the first case, foundational research is carried out in order to discover new forms of knowledge, and applied research on the other hand is to invent or discover new forms of knowledge. A research project is a formal manifestation of a research activity, and may involve a series of researchers working together in unison or harmony to achieve a stated objective or goal. The entire process of research makes use of diverse approaches, such as scientific methods (experimentation, observation) for empirical data, and the entire gamut of scientific methods and techniques may be categorized broadly into either qualitative or quantitative techniques. Mixed method techniques are also used, and we recommend the quasi-statistic approach for research in the social sciences.

Many different definitions of the term research have been proposed by many different scholars and philosophers of science. For example, John W. Creswell defines research as follows: "research is a series and sequence of structured steps that are employed in order to collect and analyze information to increase human understanding on any given topic or issue". (Creswell, 2009) In the words of Bruce A. Thyer, "the word research is composed of two syllables, re and search. When taken together they connote and imply a process of careful, systematic, patient study and investigation in some field of knowledge, and one that is undertaken in order to establish facts or derive new principles." (Thyer, 2001). According to the Merriam-Webster Online Dictionary, research is: "A studious and rigorous inquiry or examination; especially any form of careful and systematic investigation or experimentation that is aimed at the discovery and interpretation of facts, revision of accepted theories or laws in the light of new facts, or practical application of such new or revised theories or laws". Other definitions of the term have been attempted by John W. Best, James V. Kahn, Charles H. Busha, and others, but we reproduce only the most widely cited definitions here. Other types of research include descriptive research, experimental research, correlational research, exploratory research, etc, and we had discussed all these concepts on multiple occasions in the past. [21] [22] [23] [24]

- *Research Grants*

Research funding is a mechanism that provides financial support for scientific, technological, and social science studies, and is largely sponsored by government or quasi-governmental organizations (such as Fund for industrial research engagement by science and engineering research board, (Now known as Anusandhan research foundation) Department of science and technology, Department of biotechnology in India), private foundations and non-charitable entities, universities, and commercial and business corporations, most commonly through the mechanism of grants, fellowships, or schemes to cover personnel, equipment, and expenses for important and meritorious research projects. This is also known as research sponsorships, and may include both commercial and non-commercial types. The former is given to commercial enterprises, and the latter is given to universities, mostly. In the USA, US Federal funding sources include the department of defense, the John E. Fogarty international centre, the National endowment for the humanities, the National science foundation, National institutes of health, etc. India also has a research, development and innovation scheme to boost private sector research and development in fields such as artificial intelligence, deep tech, biotech, and energy. The Anusandhan national research foundation as India's apex statutory body was established to provide high-level strategic direction for scientific research and innovation, and entrepreneurship under government legislation.

We also have the council of scientific and industrial research, the department of biotechnology and the Indian council of medical research providing endowments and grants, along with private and philanthropic foundations such as the Wellcome India trust. Other important research bodies include the India space research organization, and the department of atomic energy. In the European union, we have funding organizations such as the European research council, Horizon Europe, Deutsche Forschungsgemeinschaft. The Rhodes scholarship is awarded to students studying at the University of Oxford. In Japan, we have the Japan society for the promotion of science, and in China, we have the China scholarship council. Australian research council is the most important research funding organization in Australia. Funding generally covers university fees, collateral costs, purchase equipment, travel, and other overheads. Types of research grants include core research grants for established researchers, startup research grants for early career scientists, fellowships such as the JC Bose fellowships, and advanced research grants for high impact research or fundamental and applied research. [25]

There are many different types of research sponsors. In house research funding by universities is common in some cases; industry academia collaboration is common in some cases, research is sponsored by corporate entities. We also have concepts such as research as a service, and corporate research contracts. We also have research outsourcing to

[21] Callaham, Michael; Wears, Robert; Weber, Ellen L. (2002). "Journal Prestige, Publication Bias, and Other Characteristics Associated With Citation of Published Studies in Peer-Reviewed Journals". *JAMA*. **287** (21): 2847–50

[22] Eisner, E. W. (1981). "On the Differences between Scientific and Artistic Approaches to Qualitative Research". *Educational Researcher*. **10** (4): 5–9

[23] Schwab, Michael, and Borgdorff, Henk, eds. (2014), *The Exposition of Artistic Research: Publishing Art in Academia*, Leiden: Leiden University Press

[24] Wilson, Nick and van Ruiten, Schelte / ELIA, eds. (2013), *SHARE Handbook for Artistic Research Education*, Amsterdam: Valand Academy, p. 249

[25] Lequeux, James (2021). "Urbain Jean Joseph Le Verrier: Predictions Leading to Discovery". *Neptune: From Grand Discovery to a World Revealed*. Historical & Cultural Astronomy. Cham: Springer International Publishing. pp. 159–183

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

developing countries such as India, and the latter type has become increasingly common in recent years. We also have research fellowships. A research fellowship is a funded research position, typically at a university or research institution, and one that allows researchers, regular academics, and post doctoral fellows, to focus on specific research projects, by providing financial support in the form of stipends and grants for a stipulated period in order to allow them to conduct or carry out research. A research fellowship must be differentiated from a research grant because the former is individual-centric, while the latter is project-centric. Other types of research models can exist, and research models may vary widely on a case to case basis. In India, in addition to Prime Minister's research fellowship, we may have the TCS research scholar program, the JN Tata endowment, for example. In China, the ministry of science and technology provides research funding programs.

To mention this in brief and in passing China's university system comprises of a three-tier degree structure with bachelor's, master's, and doctoral programs with several public, government-funded and private institutions, for which admission is provided through the "Gaokao" exam. The Chinese system is known for its emphasis on meritocracy, strong teacher respect, and the new "Double First-Class" universities. India's university system comprises an impressive system of central universities, state universities, private universities, and deemed to be universities, in addition to specialized institutes of national importance with prime examples being IITs, IIMs, and AIIMS. India also has several affiliated colleges and autonomous institutions. Of late, several foreign universities have been established in India, and India universities have also set up or established campuses abroad. These include the esteemed and privileged Indian institutes of technology which have set up campuses in places such as Zanzibar. Of late, there have been several r&d and science initiatives by the Indian government, and there are several tax rebates and tax concessions for Indian universities as well. Examples of research and development initiatives in India include recently established missions such as the India AI Mission, National Quantum Mission, Semiconductor Mission, and supporting frameworks like the Atal Innovation Mission.

III. KEY RECOMMENDATIONS FROM THIS PAPER

However, we believe that many more changes and improvements are required, and the following are the key recommendations arising and emanating from this paper, and from our previous publications on the subject. As a part of all this, we also need research in India, think in India, and invent in India missions, naturally. Such programs and policies need to combine all the features and aspects detailed below:

- The education system in India must be comprehensively redesigned on the lines we had recommended and suggested; we had written extensively on this in the past, have published a large number of papers on the subject, and we recommend that all these measures be implemented as quickly as possible. This kind of a reform must be carried out right from the primary level, and various Indian states share case studies and best practices in this regard. Developing nations may also help each other to the degree and extent it is required.
- Courses on scientific method and critical thinking must be made compulsory in schools, and this must replace rote learning at least to some degree and measure.
- Courses on scientific method and critical thinking must be made compulsory in colleges and universities, albeit at a higher level of detail. Such courses must prepare students for future courses on research, and these may be combined with knowledge in vertical domains as required.
- Scientific method and the philosophy of science must be brought uptodate with the latest developments in the field, and developing nations too can take the lead here.
- AI and automation of education may be attempted wherever practical, and automation of research courses may be attempted too.
- More private universities must be encouraged to be set up in India, and these must be encouraged to carry out research as well. In India, tax concessions are available for such institutions under the Income tax act of 1961, (GST benefits and Section 80G benefits are also available) but these alone have not attracted enough universities into the sector. We also recommend that private corporate houses be encouraged to set up universities as well through invitation, and through land and other incentives being provided by state governments, though this is naturally bound to be an extremely slow process.
- Ramping up the quality of education in government schools can create a ripple and cascading effect on the higher education sector, and we had written extensively on this in the past as well, and developing countries can and must take the initiative and lead in promoting new technologies such as artificial intelligence in education. There is no need to wait for developed nations or the western nations to take the lead and the initiative. This is a mindset we must break. This will also boost investments in the higher education sector, and the university system.
- More foreign universities must be set up in India, and these must be encouraged to carry out research as well. This must be done through invitation, and all leading foreign universities must be contacted in this regard.
- Greater industry academia collaboration must be instituted, fostered and encouraged in the form of consulting and resource deployment. This will also naturally boost revenue streams for universities and research institutions, and consulting can also be provided to foreign universities as required. Tax concessions are indeed available in India under the companies act, but the lack of research institutions is most certainly the bottleneck.
- Greater horizontal collaboration between developing nations must be fostered and instituted, as many

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

developing nations often have the same kind and same set of problems.

- Indian universities must be encouraged to set up campuses abroad, and this is already happening, albeit at a slow pace.
- The Indian government must shed its dogma and promote or set up universities directly in vital areas of science and technology, and also in the social sciences as required in the public sector. This may be required in sectors where private sector companies are loathe or reluctant to make investments due to concerns of low levels of return on investment.
- The Indian government must formally study university systems worldwide, university funding systems worldwide, and research models worldwide including more unique and less conventional research models worldwide, in order to come up with suitable recommendations. This must include a study and a formal assessment of less developed countries as well. Horizontal collaboration models can play a major role here.
- India does not have a single university in the world's top one hundred university rankings; the central government must investigate the causes for this by means of a root cause analysis, and strive to set this right in due course. Differences must naturally be tied to research outcomes, and research performance as well.
- Attempts must be made to improve general and research infrastructure in Indian universities, and we look forward for the central and state government initiatives in this regard.
- The curricula in Indian universities is generally seen as being outdated; efforts must be made to remediate this through international collaboration; we had provided our thought in our papers as well, and needless to say, curricula must be updated from time to time in a systematic fashion.
- Ideologies still permeate science in India; examples of such ideologies include Hindutva, Dravidian nationalist ideologies and Marxist-Communist ideologies. These negatively impact research in many fields, and must be nipped in the bud. This may eventually happen as academic Marxism is virtually a dead horse, but Hindutva and Dravidian ideologies may linger on for some time longer.
- Efforts must be made to reverse the brain drain, and the migration of talented teaching staff and auxiliary research staff overseas; the causes for such migration must be understood as well as a remediation be performed wherever possible; we recommend that social sciences research techniques be gainfully employed here, such as ethnography, participant observation method, netnography, interviews, surveys, and questionnaires.
- The causes of low research in private universities must also be understood.
- Private research sponsors must be roped in, and we would like to see this materialize and fructify through a gradual awareness generation process. We would also like to see the research sponsorship as a service model take off in India.
- Methods and techniques may be developed to assess and evaluation of social and scientific worth of research being carried out, or research proposed to be carried out; the downstream implications of research must also be understood, and we believe that even developing counties can take the lead here, instead of relying solely on developed ones.
- The social and scientific worth of research to be carried out may be used as a heuristic for research funding criteria and research funding decisions.
- Instances of bureaucracy, red tape and nepotism in universities, particularly government ones, need to be identified and understood, so that performance can be tied to improving the efficiency of administrative and non-administrative processes.
- The setting up of prestigious journals in India needs to be encouraged through publishing houses, and such journals needs to be guided on best publication practices as well.
- A meaningful and workable set of linkages need to be established between real-world problems and scientific research; the government can deliberate on how this can be achieved and accomplished, and can set up a think tank and governing body on this.
- Salary and remuneration issues to research staff in government universities and research institutions need to be addressed; this will lead to a gradual remuneration increase in private universities and research institutions as well.
- Attempts to deal with research fraud and paper mills need to be instituted; paper mills produce fake and falsified research papers, and therefore severely challenge the quality of the research ecosystem. We need a strong oversight mechanism, and a strong set of whistleblowers here; violations of ethical standards need to be reported, and findings even published in other peer-reviewed journals if necessary.
- A strong emphasis must be placed on foundational research; examples of research on foundational areas could include research methodology and the philosophy of science, for example.
- A strong emphasis must also be placed on applied research and the commercialization of research; a list of potential projects available for further downstream research, scrutiny, and commercialization prospects must be made available from time to time.
- Open access movements such as Shodhganga movement must continue to be promoted and encouraged.
- A continuous dialogue must be maintained by the government by both institutional and non-institutional researchers so that their grievances are voiced, heard, and addressed.
- Copyright and patent laws must continue to be reviewed and revised from time to time; In India, the governing statutes are the Copyright act, 1957, and the Patent act, 1970.
- The issues faced by online research activities also need to be suitably probed and investigated; examples of such issues include control and oversight issues, cultural barriers, communication barriers, etc.

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

- The scientific culture of the nation must be assessed from time to time, and a SWOT analysis or a strength, weakness, opportunity, threat analysis performed from time to time.
- Public trust in science and scientists must also be gauged and assessed from time to time, and the results used to determine the course and direction of future research if possible.
- Science communication must be treated as a distinct activity, and the best practices identified and observed in this regard and connection.
- The social responsibility of scientists and researchers towards science, society, and the education system must be fostered and inculcated in addition to academic freedom alone.
- Data driven research must be promoted and encouraged in lieu of mostly abstract theorization, and data must be collected from as many sources as possible including all representative and relevant ones.
- Interdisciplinary and transdisciplinary research must be promoted and encouraged wherever possible.
- The government must also clearly understand between science and the economic output and promote science accordingly it vital fields.
- Research must be coupled to practical inventions and discoveries as far as possible.
- The government must also promote outsourcing of scientific activity and research and development aggressively from developed countries in particular.
- The government must also aggressively pursue the ”Research as a service model” or the Raas model. For this to happen successfully quantum improvements in the education system will also be required.
- More international scientific symposiums, conferences, workshops, and seminars must be held in India, and while this process has started, it needs to be accelerated along with theme, subject, and field specific scientific symposiums, conferences, workshops, and seminars.
- Special interest groups, blogs, thread and online forums can also be promoted and encouraged by governments.
- In addition to scientific journals, online and offline scientific magazines, periodicals, and bulletins must also be encouraged by the government, and many can be promoted by the government too.
- Better rewards and recognition systems for scientists need to be instituted. The existing get up falls short of expectat6ions, and many awards do not carry cash awards.
- Experts from around the world need to be courted to India to train Indian scientists, researchers, and scholars; NRI scientists can be courted and lured back to India too to reverse the brain drain.
- In addition to scientists, India must also foster and inculcate intellectuals and thought leaders who can guide the government on important policy matters and the like.
- Mentorship programs need to be instituted for early career scientists and budding scientists.
- A thriving ecosystem must be built for informal and non-affiliated researchers, and research grants need to be made available to them as well.
- A strong and thriving business environment is also important because it will have a ripple and cascading effect on the research ecosystem.
- Better economic development models are also important because they will have a ripple and cascading effect on the research ecosystem.
- A scientific temper must be fostered and inculcated at all times, and rationalist and other science organizations may be roped in for this. Science activism must also be promoted as necessary.
- Ethics must be promoted in science, and if possible be taught as a part of course content.
- Ideologies in science must be relegated to the background, and if possible, be obliterated completely.
- The social responsibility of scientists must be stressed and emphasized at all times, and scientists must be made aware of their duties towards science, society and the education system.
- Careerism in science must be kept to the barest minimum, and so must be academic rivalries.
- The government must also institute a metrics and measurements program, and various metrics must be tracked from time to time; remedial action must naturally emanate from this.
- Researchers must be encouraged to develop local perspectives of issues without losing sight of the bigger picture. This is particularly true of the social sciences.
- Indian universities are still nowhere near American universities in internal ranking of top universities; In the meanwhile, Chinese universities are leapfrogging ahead. This is something than needs to be addressed, and a root cause analysis performed.
- A root cause analysis for the low performance of Indian scientists and researchers in winning high-end international prizes needs to be performed, and remedial action taken as necessary.

IV. CONCLUSION

The objective of this paper was to explain and enumerate why we need to replicate the success of the American research ecosystem everywhere, and to explain why doing so could lead to quantum advancements in science everywhere, particularly in the developing world. We suitably began this paper by reviewing the history of education systems worldwide, and then proceeded to define vital terms such as a university and a research university. We also briefly traced the history of the American university, and briefly probe and investigate the American university system, the American research ecosystem, and American research funding models. We also briefly discussed the general idea of research, the different types of research, and the different types of research funding models worldwide. As a part of this exercise, the different types of research grants including research fellowships were also probed and investigated. Other aspects such as research scholarships, corporate funded and corporate sponsored research, industry academia collaboration, research outsourcing, research contracts, and research as a service are also reviewed. A large number of recommendations were

ISSN No:-2456-2165 https://doi.org/10.38124/ijisrt/26jan787

also proposed as a part of this paper, and these would as such constitute the core essence and meat of this paper. We do therefore, hope, expect and anticipate that this paper would become a vital one in our overall globalization of science mission and objectives.