

SCIENCE EDUCATION AND RESEARCH: INPUT TO NATIONAL EDUCATION POLICY, 2015

Discussion Meeting, IISER, Pune July 22-23, 2015



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Educate India : Challenges

- 665 Universities and 36,000 colleges
- Private to public : 70 : 30. In Andhra Pradesh and Telengana, share of private universities is ~ 80% !
- 30 million students enrolled in colleges and universities
- 80 % of students in undergraduate education; < 0.3 % in PhD programmes
- 1.34 million teachers with Pupil –Teacher Ratio of 23
- GER in higher education : 22 % ; from 12 % in Bihar to 45 % in Tamil Nadu
- Investment in education as % GDP : 4; Higher Education: 0.4 %(www.worldbank.org)

Higher education : Trends

- State progressively withdrawing from higher education
- Private sector and self financed institutions filling the space vacated by the state
- Opening of higher education space to foreign universities
- Private universities awaiting legislative approvals in many states
- Large number of students in affiliated colleges pursuing undergraduate education
- Vast disparities in access and quality

Issues that need attention

Balance between teaching and research; delivering frill free quality education at the lowest cost and preparing the student for a world beyond academia

Challenges in framing a policy : going beyond homilies

- Is one over-arching policy (one size fits all) cutting across India's diverse institutions of higher education feasible ?
- Should we have differentiated policy for institutions? Is “elitism” in education acceptable in India?
- Education is a state subject; implementation lies with the state. A centrally devised policy can be at best a guideline.
- Should the policy for science education focus only on undergraduate education? Is it necessary or pertinent to include post graduate education and PhD research in the policy given that this constitutes a miniscule portion of the students enrolled.
- Should we not define the “ winds of change” in our society to define the context of higher education in the next decades? What is different today that needs fresh ideas? Can we envision the world ten years hence when our current students will enter the work force? Are we preparing them for a world they are likely to encounter?

“Unless we understand the future for which we are preparing, we may do tragic damage to those we teach”

A. Toeffler, Learning for Tomorrow: The Role of the Future in Education, Vantage Press, New York, 1974

WHITHER SCIENCE EDUCATION IN INDIAN COLLEGES?

Urgent reforms to meet the challenges of a Knowledge Society

Dr. Catarina Correia | Dr. Leena Chandran-Wadia | Radha Viswanathan | Adithi Muralidhar



Students of the Pardhi community (a nomadic tribe) from Yamgarwadi, Maharashtra, explain the structure of DNA Sir Harold Kroto, Nobel laureate in Chemistry in 1986, during an interaction at a function organised by the Observer Research Foundation Mumbai

Foreword by Bharat Ratna Dr. C.N.R.Rao

“Every classroom in the country must echo with the excitement and curiosity of science”



Observer Research Foundation Mumbai

Ideas and Action for a Better India

State of Science Education

- *Poor quality of teaching*
- *Inadequate infrastructure*
- *Inadequate funding*
- *Low employability and poor career options*

Recommendations

- *Strengthening the university system and colleges*
- *Improving the quality of leadership*
- *Improving the quality of teaching*
- *Improving the accountability of teachers and institutions*
- *Improving the curricula*

2014

Whom are we teaching ?

How well have we understood the demands of the millennial generation?

- Attitudes
- Aspirations
- Mental stimulation
- Comfort levels with technology
- Engagement, involvement, interaction and social media

Making the transition from teacher centric to student centric education

Role of a research university : Dilemmas

- Student success vs faculty success
- Knowledge creation vs knowledge delivery
- The ambivalent faculty attitudes towards teaching
- Sage on stage vs mentor and coach on the side
- Pedagogy of learning : Practice and experiential vs text book and examination
- Education to make a living or education for living a life as a productive citizen
- Knowledge vs skills
- From STEM to STEAM : integrating arts, social sciences and humanities with S&T

Invigorating Education, K. C. Nicolaou, Angew. Chem. Int. Ed. 50, 63 (2011)



Time to Decide

The Ambivalence of the World of
Science Toward Education

Vikram Savkar
Jillian Lokere
Cambridge, Massachusetts
April 2010

nature EDUCATION
Position Paper

Sponsored by 

www.nature.com/scitable/forums/timetodecide

- Education is a charged and troubling topic for scientists at institutions of higher learning. Despite their personal feeling that education is important, many academic scientists eschew teaching in favor of research.
- Most universities despite having a publicly stated mission of education direct more funding, awards, and job security to outstanding researchers than to outstanding teachers.
- This ambivalence creates a divide between the professed values of the science community and our decisions, between the educational outcomes we hope for and the ways we allocate time and resources.

Is undergraduate research relevant in the Indian context?

- Inadequate pre university training in enquiry based education makes research training impractical for all undergraduates
- Undergraduate research only relevant to a select few
- A three year undergraduate programme hardly offers sufficient time for research in a laboratory
- Inadequate infrastructure for research in most institutions (faculties, laboratories)
- Expensive and unaffordable in most institutions
- A large proportion of career opportunities for undergraduates lie outside of academia; so why burden them with research ?
- Even in institutions offering a five year integrated programme with a year available for research, should all students be forced to do academic research ?
- Can we prepare the students for a world outside of academia? Such as, in law, media and journalism, management, entrepreneurship, school teaching etc ?

Universities in crisis

- American Universities at Risk, Richard N Zare, *Angew. Chem. Int. Ed.* 52,112 , 2013 : *Is higher education a private benefit to the individual graduates or a public necessity that benefits society at large ?*
- The End of the University as We Know It : N.Harden; <http://www.the-american-interest.com/2012/12/11/the-end-of-the-university-as-we-know-it/>, December 11, 2012 : *The higher education revolution is coming. Just a few decades hence, half the colleges and universities in the United States will have disappeared*
- The American Higher Education System is Spectacularly Inefficient, M. Nissen, [http://www.businessinsider.in/Americas-Higher-Education-System-Is-Spectacularly Inefficient/articleshow/23373939.cms](http://www.businessinsider.in/Americas-Higher-Education-System-Is-Spectacularly-Inefficient/articleshow/23373939.cms)

Crisis is a consequence of our inability to see the future; it has no relation to the relative levels of affluence or penury of a society

Excellence in universities is dependent on..

- Institutional Governance; balance between autonomy and accountability
- Diversity (social, ethnic, geographic, income, gender, language etc.)
- Financial resources
- independence of thought
- Quality of faculty
- Quality of students

Autonomy and accountability

- Government funded vs private universities
- If funded by Government, what should be the extent of autonomy ? How should Government create oversight mechanisms?
- What should be the governance structure of private universities or self financed institutions ?
- Autonomy for what : Curriculum and course design, hiring faculty, research focus; faculty compensation, student fellowships and stipends, where and how to spend the money?
- Accountability to whom: students, faculty, community, industry or political masters ?

Financial Resources

- Inter-se resource allocation for teaching and for research; What part of this must be subsidized by the state?
- How can our institutions raise resources outside of state support ? How do we build and manage endowments?
- Should higher education be subsidized for everyone? Can there be a more rational fee structure with support to those who cannot afford to pay?
- Do we need a new model of funding Universities? Government funded and Government managed, Privately owned and privately managed, publicly owned and managed by a public trust ?
- How can Government balance the resource demands of lifting the average against support to centers of excellence ?

Public funding of S&T is under stress worldwide. We need a new argument to sustain society's interest in and support for scientific research and education

PUBLIC FUNDING OF SCIENCE IS IN A CRISIS WORLDWIDE

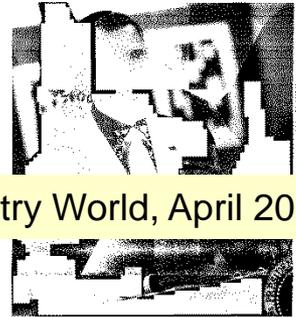
Chemistry World, September 2014, p.7

NEWS AND ANALYSIS

Obama's science budget disappoints

US Funding falls to keep pace with inflation

US researchers and science advocates are expressing significant disappointment at funding proposals for research agencies in President Obama's budget request for 2015. The proposed increase only allows agencies to keep their head above water, therefore the opportunity for new funding for chemistry and other disciplines will not be very bright, warns Glenn Rusklin.



Science advocates have been disappointed by the president's proposed budget

one can muster, it's a strategic error that needs to be corrected says Research America president and chief executive Mary Woe. Many researchers have already been forced to adjust their life and staff planning research, clinical trials, leaving patients with more delays to access new treatments and therapies.

Flat cash
They follow Democrat Bill Clinton, Barack Obama, who serves the science, space and health, and education, oversees nearly 20 research areas and agencies.

Scientists' research energies are being focused on the most important areas, but overall there will be a net loss of research dollars, according to the American Association of University Professors (AAUP). The AAUP report notes that the 2014 budget will result in a 1.2% increase in total federal funding for R&D, an increase of 1.2% from the current level. Meanwhile, non-federal R&D would receive \$63.9 billion, an increase of 0.4%, and basic research would receive \$32.1 billion, which represents a reduction of about 1%.

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Above and beyond
The Institute of Medicine (IOM) has issued a report titled 'Above and Beyond: Opportunities for Growth and Security in the 21st Century'. The report calls for a 50% increase in federal funding for R&D by 2025, and a 100% increase in private sector R&D by 2025.

Meanwhile, the research lobby has been comforted by the fact that the president has submitted to Congress, alongside his budget proposal, a separate \$16 billion Opportunity Growth and Security Initiative that would provide an extra \$2.5 billion for R&D activities. This would include an additional \$970 million for the NIH, \$686 million for NOAA and \$553 million for the NSF. But that proposal will need congressional approval.

But many US research lobby groups are not enthralled. "The scientific funding levels for these

years are the lowest since 1965, and the rate of the budget request does not reflect the opportunity costs of doing without the research that we are losing," says Rusklin.

He adds that the budget request would also replace the appropriation cuts slated to begin in 2015 with new spending cuts, added tax revenue and immigration reform.

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Chemistry World, July 2014, p.6

NEWS AND ANALYSIS

Australian science base eroded by cuts

FUNDING Scientists' dismay decisions as 'poison'

Australian research community is suffering from what has been described as 'short sighted and politically motivated cuts, enshrined in the new conservative government's budget'.

Only medical research emerges as a real victor, with the erosion of \$450 million (21 billion AUD) by 2014, but several three will struggle to maintain research in Australia in the near future, according to Ian Field, science policy adviser at the Australian Academy of Science. Field says the government 'failed to realize that tactical research needs underlying expertise in the chemical and physical sciences, and that support is being eroded'.

It is an eye for the beholder, says Michael Regan, secretary of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), which, along with the medical field, are the two sectors that are being protected in the new budget. Field believes the short-term approach the government is taking. "The fact is we need to have more information you need and how to support it - we don't know the lifetime of a government."

Environmental groups, unions and renewable energy are all big casualties of the budget, most notably the federal abolition of the Renewable Energy Agency

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Fee funders
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Portuguese chemistry faces disaster

FUNDING A third of academic chemistry labs could close

Scientific research centres across Portugal are facing dramatic funding cuts following a large-scale review carried out by the country's Foundation for Science and Technology (FCT). The chemical sciences have fared particularly badly, with more than a third of chemistry departments evaluated set to receive no or minimal funding over the next five years, putting them at significant risk of closure.

The decision is part of the 2013 evaluation of R&D units across all research centres carried out by the FCT, the main government organisation responsible for funding research in Portugal. During the first stage of the evaluation, research centres are reviewed and graded by panels of experts appointed by the European Science

Foundation, based on several criteria including scientific merit, productivity and strategic plans.

Only those deemed "very good", "excellent" or "exceptional" will move on to the next stage of the review, while the remainder will be placed in a large-scale review carried out by the country's Foundation for Science and Technology (FCT). The chemical sciences have fared particularly badly, with more than a third of chemistry departments evaluated set to receive no or minimal funding over the next five years, putting them at significant risk of closure.

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"FCT funding is vital for chemistry research in Portugal," explains Anthony Burke, a chemistry professor at the University of Évora's chemistry department, which is one of the groups affected. "Besides R&D funding, the FCT is the principal source of funding for chemical research, including PhD and postdoc scholarships. There is a real risk that if they are not funded, it will be a disaster for the country's chemistry research."

"Several chemistry research centres have not passed the second stage of the evaluation process, which essentially condemns them to extinction," they said in a statement. "Some of these research centres have significant indicators of scientific productivity, based on the fact that they regularly received 'excellent' or 'very good' ratings in previous reviews."

But the FCT strongly denied that its assessment methods were in any way flawed. It issued a statement saying it had "total transparency, rigour, independence and in line with the highest international standards."

Research centres can appeal the FCT's decision, and some have already begun the process, Emma Sneyd.

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Chemistry World, April 2014, p.9

increasingly spending, according to science agencies, the worst for decades to the European budget approved in December 2013.

Specifically, the president would provide \$13.4 billion in federal funding for R&D, an increase of 1.2% from the current level. Meanwhile, non-federal R&D would receive \$63.9 billion, an increase of 0.4%, and basic research would receive \$32.1 billion, which represents a reduction of about 1%.

Inflationary pressures
Some of the biggest research agencies, like the National Institutes of Health (NIH), the National Science Foundation (NSF), NASA and the Department of Energy (DOE), would see their budgets increase 1% or less under the president's proposal. NIH's funding would reach \$30.2 billion, NSA's would go to \$7.3 billion and the Department of Energy's Office of Science would hit \$2.1 billion. NASA, too, would see its overall budget rise about 1%, but its science budget would fall by about 3.5% to \$5.15 billion.

The president's funding requests become clearer after accounting for inflation. For the

years are the lowest since 1965, and the rate of the budget request does not reflect the opportunity costs of doing without the research that we are losing," says Rusklin.

He adds that the budget request would also replace the appropriation cuts slated to begin in 2015 with new spending cuts, added tax revenue and immigration reform.

But many US research lobby groups are not enthralled. "The scientific funding levels for these

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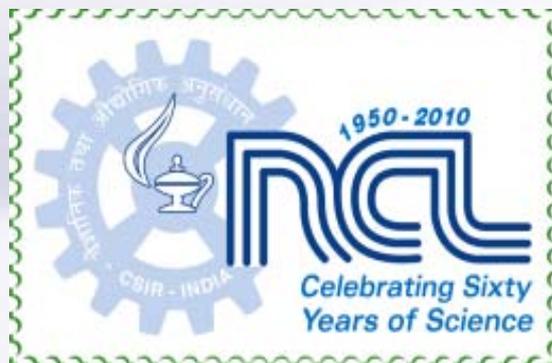
How do we measure excellence ?

- Why do we need metrics? What value does it bring?
- What should be the metrics?
- Should the metrics be designed within a socio-cultural context or excellence can be universally standardized?
- Is the current system of accreditation by NAAC appropriate?
- Can there be one metric for all Indian institutions?
- How will metrics be used ?

How should Government exercise oversight ?

- Monitor performance at periodic intervals
- Provide funding linked to institution's performance
- Minimally interfere in operational matters
- Provide full autonomy in all academic matters to the faculty
- Encourage and incentivize institutions to raise extra budgetary resources
- Ensure broad based self-governance structure involving faculty, students, academic peer groups, industry representatives and community leaders

Government must restrict itself to defining policies and guidelines, leaving much of the operational responsibilities to the university/institution itself



THANK YOU

