

Singapore Higher Education

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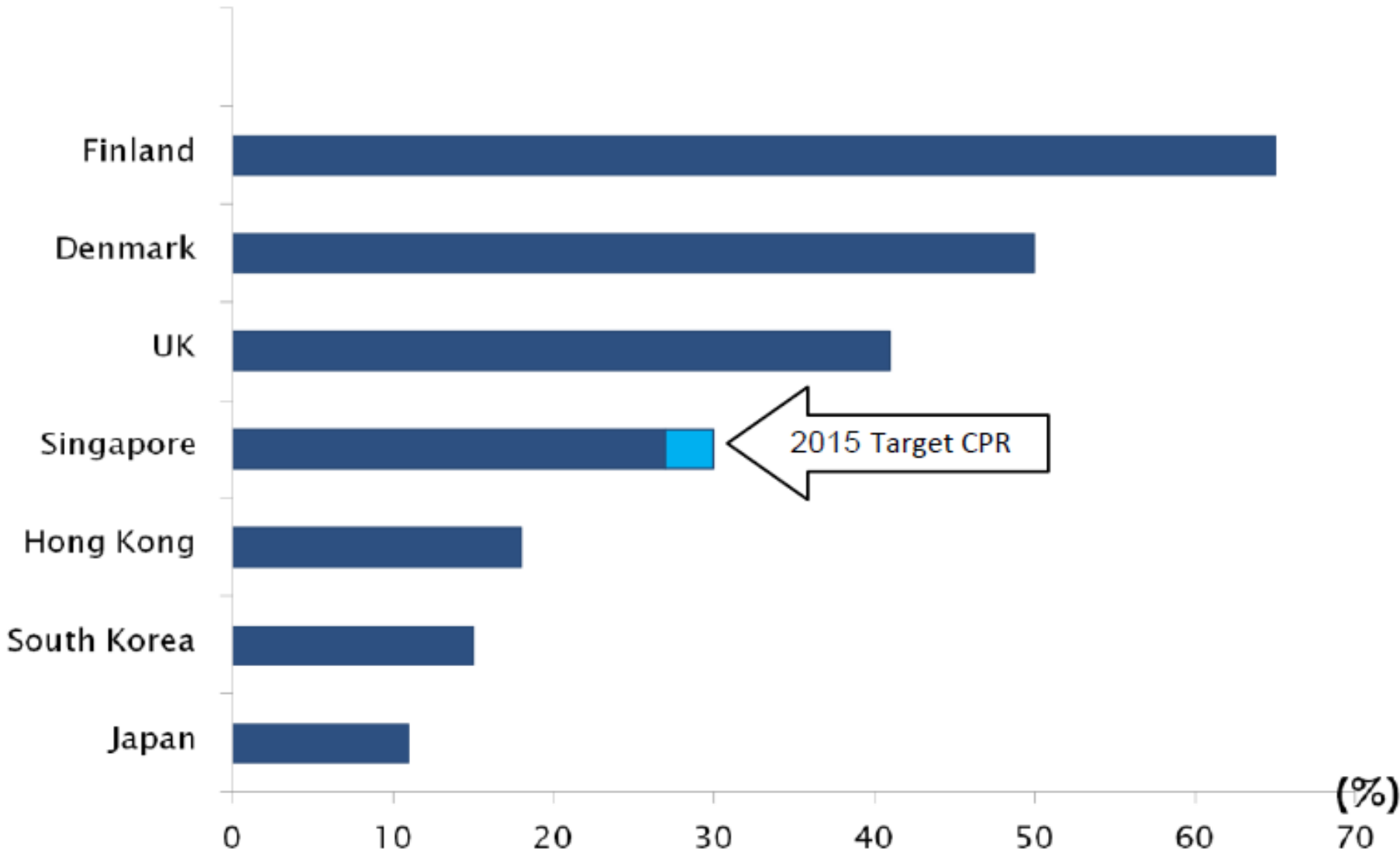


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- Vice-President Research Strategy; Dean, Faculty of Engineering; Director, Center for Nanofibers & Nanotechnology; Director of NUS Enterprise; Director of Technology Licensing Office @ National University of Singapore (NUS)
- Author of book *Changing Face of Innovation*; Founder, Global Engineering Deans Council (www.gedc.org); Co-Founder of University Excellence Care Project (www.uecare.org).
- Thomson Reuters identified him among the World's Most Influential Scientific Minds
- Highly cited researcher (highlycited.com). 700 ISI papers, 40,000 citations; 92 H-index
- PhD, University of Cambridge; The General Management Program, Harvard University
- Elected Fellow, professional societies & academies of Singapore, UK, India, ASEAN & USA

Cohort Participation Rate, CPR



Singapore: Publicly funded university CPR in 1980s ~ 5%

(1905/1960/1980) National University of Singapore (NUS)

(1980/1991) Nanyang Technological University (NTU)

(2000) Singapore Management University (SMU)

(2009) Singapore University of Technology & Design (SUTD)

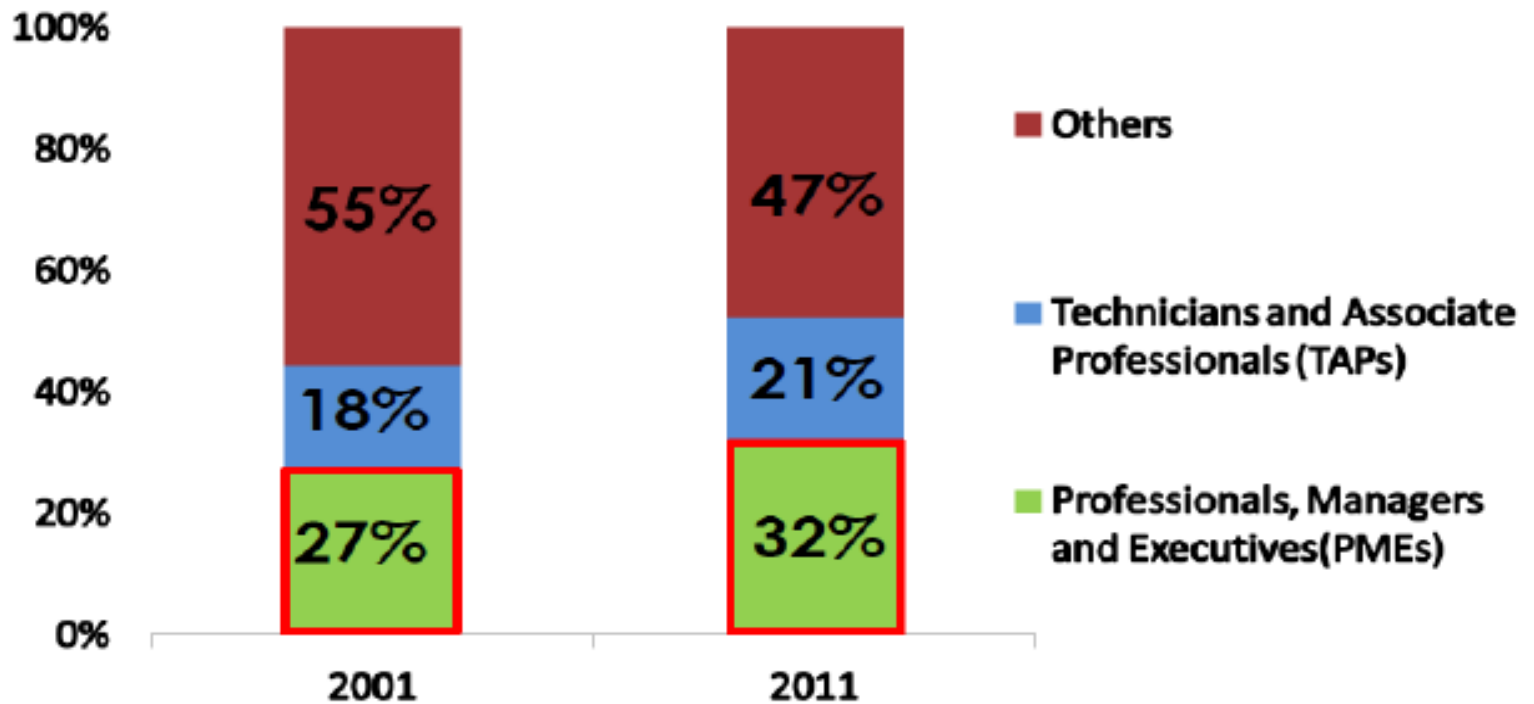
(2009) Singapore Institute of Technology (SIT)

Government recurrent expenditure

on education ~ \$10 billion (3.7% of GDP)

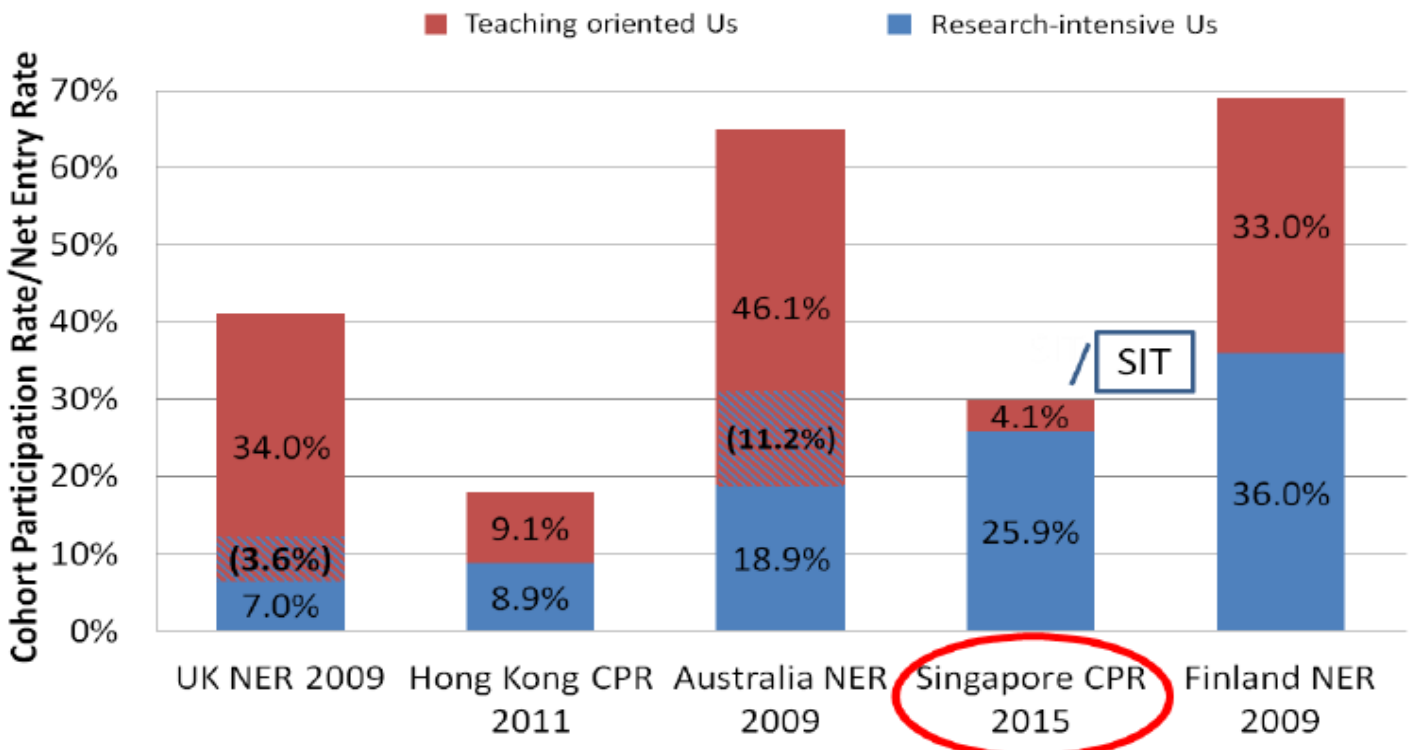
on universities ~ \$3 billion (1% of GDP)

Singapore employment trend



Source: Ministry of Manpower

Figure 4.1: Publicly-Funded University Landscape in Different Countries – Proportion of Research-Intensive to Teaching-Oriented Universities.⁴⁸



* Numbers in parenthesis refer to % of cohort in “aspirant” research-intensive universities.

Singapore

Enrollment in public universities ~ 60,000

Intake of public universities ~ 17,000

Private Higher Education

- ~ 150,000 students enrolled in ~70 private higher education providers.
- ~ 100,000+ are overseas students. Polytechnic students form the bulk of Singaporean students

Most of PEIs do not have degree-awarding status and instead, offer the degree programs of its overseas university partners.

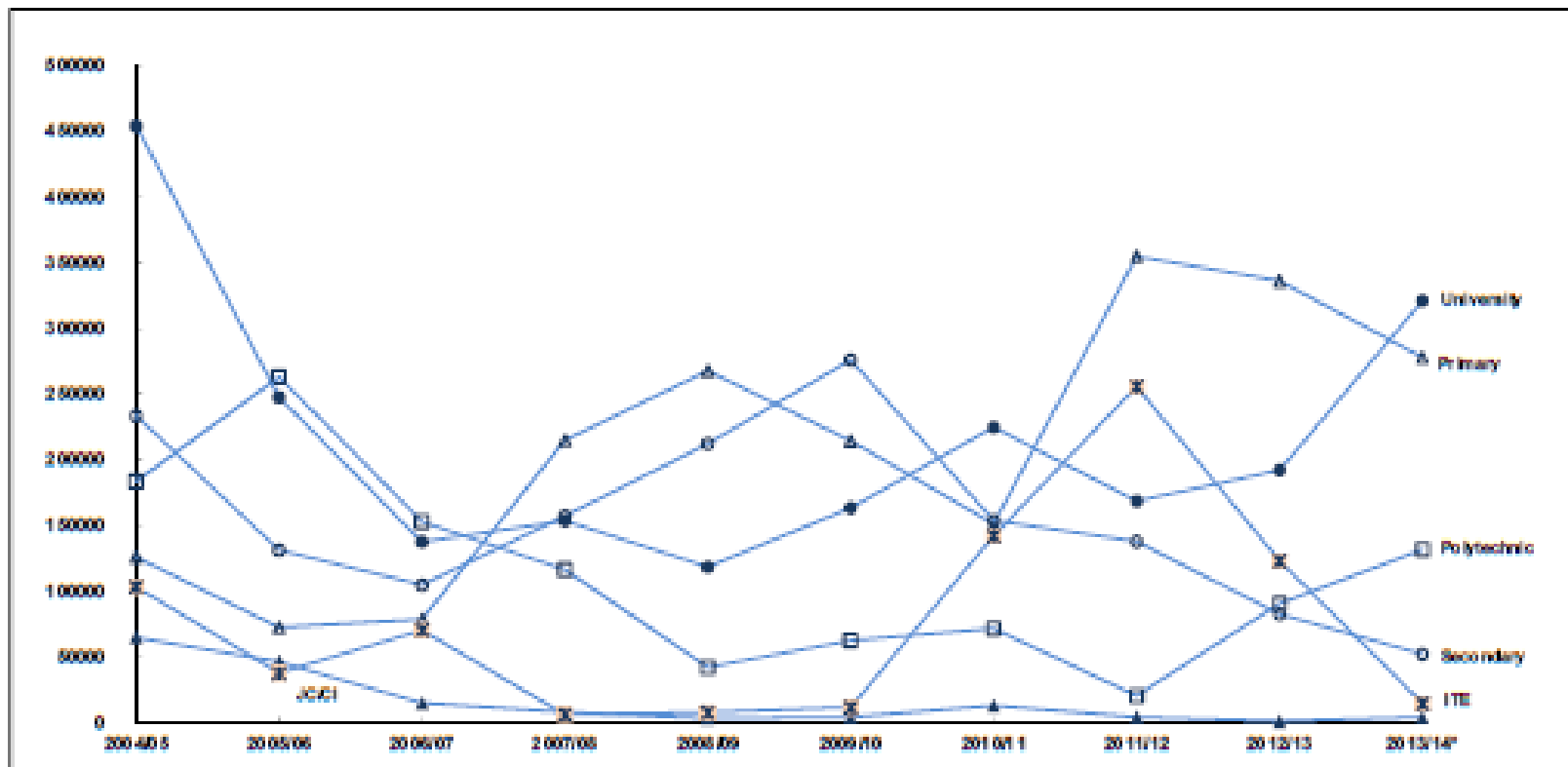
CPE manages a two-tier regulation framework – the mandatory Enhanced Registration Framework (ERF) and the voluntary EduTrust certification framework.

Table 6.3: ERF and EduTRUST Requirements

ERF	EduTrust
1. Corporate governance	1. Management commitment and responsibilities
2. Quality of provision	2. Corporate governance and administration
3. Information transparency	3. External recruitment agents
	4. Student protection and support services
	5. Academic processes and assessment of students
	6. Quality assurance, monitoring and results

Source: Council of Private Education.

GOVERNMENT DEVELOPMENT EXPENDITURE ON EDUCATION ('000 SGD)



Primary school enrollments are dropping from 300,000 to 250,000 over the past decade

QS Top student cities



1 Paris



2 London



3 Singapore



4 Sydney



5 Melbourne



6 Zurich



7 Hong Kong



8 Boston



9 Montreal



10 Munich

National University of Singapore (NUS)



Asia Rank: 1
World Rank ~ 22

~1990s

Teaching University

~ 2010

World Class University

100% faculty members with PhD degrees and research active

~ 50% faculty members are international

~ 20% of undergraduate students are international

~ 60% students go on overseas attachments

~ 60% of graduate students are international

~ 100 research centers and institutes

~ \$200,000 research per faculty member

~ 2000 PhD students



National
University
of
Singapore

M.I.T. settles in for long haul in Singapore

SINGAPORE

American university likes being involved with the first 'smart nation'

BY JANE A. PETERSON

On a sultry day in Singapore's Chinese Garden, Daniel Hastings, an engineering professor at the Massachusetts Institute of Technology, took his first ride in a driverless golf cart, one of myriad innovations M.I.T. is driving for this island nation as it prepares for a future of explosive growth.

"M.I.T. is in Singapore for the long term," said Professor Hastings, director of the Singapore-M.I.T. Alliance for Research and Technology, or Smart. His team of professors manages five new labs, paid for by the Singapore government (M.I.T. continues to pay faculty salaries during the academic year). "We have stable five-year funding to handle significant urban problems. We like the model; it works for us."

M.I.T.'s point person in the future mobility lab, Prof. Emilio Frazzoli, has just returned from Boston, where he spends 80 percent of his time, to meet with local officials and apply for a five-year contract renewal. On his team are 40 Ph.D. and post-doc researchers, a third from M.I.T.

"Singapore has the political will to innovate," he said, referring to its plan to be the world's first "smart nation." The city-state wants to blanket the island with a host of sensors, including a potential "killer app" for shared driverless cars. "Massachusetts doesn't allow us to test driverless cars. This is our living test bed."

In one of the labs, where another Smart group investigates environmental problems and is already on its second contract, Prof. Nicholas Patrikakis of M.I.T. said he too found Singapore a better fit for his research. His team builds stingray-like robots that collect data to fight ocean algae; test beds are right off the coast. "This lab was specially built for us with totally new, state-of-the-art equipment," he said. "That doesn't happen in Boston."

Other Smart labs help tackle infectious diseases, such as dengue fever, as well as drug screening and power consumption. All are housed in a gleaming new tower called Create — Campus for Research Excellence and Technological Enterprise — on the campus of the National University of Singapore.

Joining M.I.T. at Create are 10 other world-class universities from Britain, China, France, Germany, Israel and Switzerland. But M.I.T.'s footprint is the oldest and largest.

"When these programs naturally end, we will do others," said Kiang Wee Lim, executive director of Create, an entity under the prime minister's office.



INNOVATION Prof. Daniel Hastings explaining the mechanics of a driverless golf cart. Singapore wants to blanket the island with sensors to accommodate driverless vehicles.



A GOOD FIT Prof. Nicholas Patrikakis, left, displaying the inside of an underwater robot for collecting data on ocean algae. Students don't have to go far; test beds are right off the coast.

Create receives an undisclosed chunk of an ever-growing tranche of government research money, which is projected to increase 25 percent next year to an annual 4 billion Singapore dollars, or about \$3.1 billion. "We have an open talent policy for research," he said, "and we actually have a queue of M.I.T. professors willing to work with our students. That's the acid test."

Professor Hastings concurred. Smart has no trouble attracting top research scientists from around the world. "Singapore's stature is increasing year by year," he said, noting that M.I.T. has engaged in collaborations with the city-state for 15 years. "Every project is collaborative with faculty and students from N.U.S. and N.T.U.," he said, referring to the National University of Singapore and

Nanyang Technological University.

Indeed, a main reason for bringing M.I.T. to Singapore was to produce world-class local talent, especially homegrown entrepreneurs.

Apart from the labs, a Smart innovation center helps turn research into commercial start-ups by offering grants and expert advice. Of 13 companies it has helped launch, 10 remain viable. Another 27 are still incubating.

A noted star is Viasenti, a start-up that markets water grid platforms with sensors to detect water leaks. Viasenti landed its first contract with Singapore's public utility; Australia and Hong Kong utilities have also signed up.

Smart, however, is not the biggest M.I.T. project in Singapore. A few blocks away, the Singapore University of Tech-



EXPERIMENTATION A student using a 3-D printer. On one Smart project, students used these printers to build a prototype for a redesigned sanitary disposal bin for women's toilets.



LAB WORK Singapore-M.I.T. Alliance for Research and Technology, or Smart, is a team of professors that manages five laboratories paid for by the Singapore government.

nology and Design, opened in 2012, represents M.I.T.'s most ambitious education effort since its founding 150 years ago.

"Our hope is to be M.I.T. 2.0 in an Asian context," said Prof. Thomas Magnanti, S.U.T.D.'s president and former dean of M.I.T.'s School of Engineering. The school offers four core programs, one in architecture and three in engineering, all paid for by the Singapore government.

Some 100 M.I.T. professors, about 10 percent of the university's faculty, are involved, though only 10 professors come to Singapore for substantial periods during the year.

Together, they develop 90 percent of the curriculum, train faculty and welcome the top 30 students for a summer

at M.I.T. A research arm — International Design Center — has also been co-located on both campuses, partly to inspire potential entrepreneurs. So far, it has helped spawn seven registered start-ups in Singapore.

Unlike their Yale counterparts, the M.I.T. faculty has not publicly complained about limits to academic freedom in Singapore. Professor Magnanti said. While conceding that not all professors think alike, he said all activities have been vetted to garner support. "S.U.T.D. helps M.I.T. achieve its mission," he said, "to create knowledge and educate students to improve the world."

"We are constantly experimenting with different modes of instruction," he continued, adding that S.U.T.D. was

already a world leader in "cohort-based" teaching. Students — 80 percent Singaporean, 60 percent male — do not typically sit in lectures. They learn by working in teams with professors who act more as coaches than instructors.

In a basic design class, seven teams work on different group projects as two professors and a teaching assistant move from one to another offering advice. The atmosphere is convivial and relaxed, yet focused, and sometimes intense.

This month, one team of seven students, united after a "speed dating" session, was brainstorming about how to redesign a sanitary disposal bin for women's toilets. With less than five weeks left, the team sketched its design on a whiteboard, listing pointers gleaned from a survey of female students about what needed fixing.

"We are given 500 Singapore dollars to build the machine and make a video about it," said Amos Choo, 26, explaining that the group would look for certain parts in hardware shops before using school machines, such as 3-D printers, laser cutters or waterjet cutters, to build a prototype.

The bell rang and the team headed to the campus hawk center, a food court, for lunch. After choosing meals from a handful of stalls, they sat together to discuss what sets S.U.T.D. apart from other Singapore universities.

"The teaching here is very different," said Jozef Ooi. "It's not a passive learning approach." She applauded the strong school pride, patient teachers and collaborative students, as well as the unofficial motto: "Don't say we didn't invite you."

Franklin Anariba, a chemistry lecturer who joined S.U.T.D. after teaching at California Polytechnic State University, stopped at the table to offer a perspective. "The vision is why I came," said Dr. Anariba, who has a Ph.D. in molecular device fabrication. "The merger of design and engineering got my attention."

His biggest challenge in "freshmore" year — a 12-month hybrid of freshman and sophomore years — is getting students to interact. He tries to set a tone where students feel safe to voice an opinion or ask a question without fearing repercussions.

"From a faculty perspective, there is room for growth," Dr. Anariba said. "The students are committed. I want to teach them and they want to learn."

Come January, S.U.T.D. moves to an even bigger new campus near Changi Airport, built to eventually accommodate 1,000 students annually. "Our goal is to create one of the world's great universities," Professor Magnanti said. "We want S.U.T.D. on the list with Harvard, Cambridge and Oxford."

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National University of Singapore (NUS)





THOMSON REUTERS



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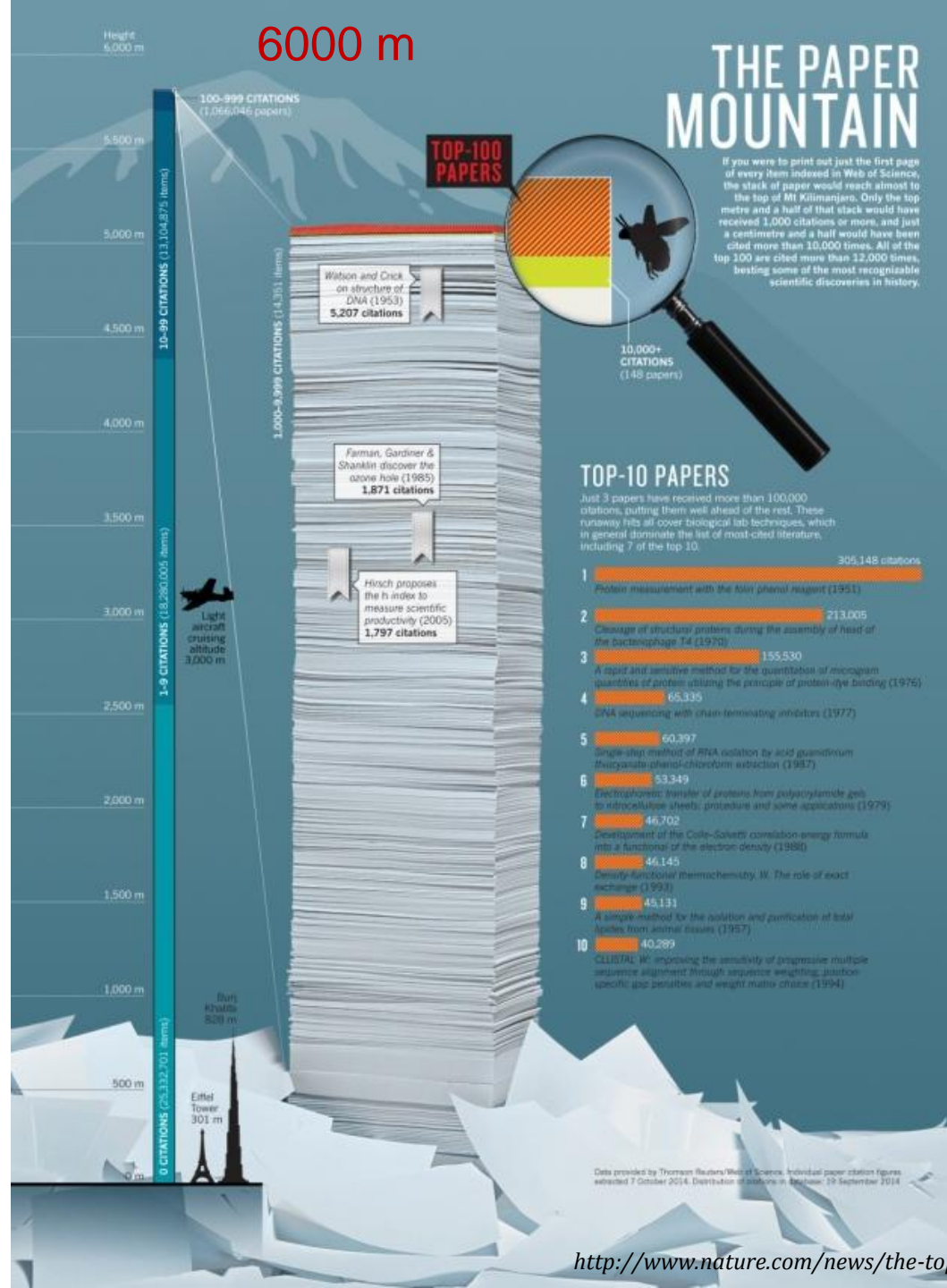
A hot air balloon soars south of High River and east of the Rocky Mountains during Day 3 of the Canadian Hot Air Balloon Championships. September 27, 2013. REUTERS/Mike Sturk

Singapore's Highly Cited Researchers



Country	Highly Cited Researchers, HCR (number) http://highlycited.com/	Population (millions)	HCRs per million population
Switzerland	67	8	8.375
United States	~ 1717	318.2	5.396
United Kingdom	340	63.7	5.338
Denmark	27	5.6	4.821
Netherlands	76	16.8	4.524
Sweden	28	9.7	2.887
Singapore	14	5.4	2.593
Finland	14	5.4	2.593
Germany	163	80.7	2.020
Israel	13	8.2	1.585
Norway	7	5.1	1.373
France	84	65.9	1.275
Japan	98	127.1	0.771
South Korea	21	50.4	0.417
Taiwan	8	23.4	0.342
Turkey	10	76.7	0.130
China	160	1365	0.117
Malaysia	3	30.1	0.100
India	11	1245.2	0.009

Thomson Reuter's
Web of Science
holds some 58
million items



Pre-historic;
Early; Ancient ages

Middle Age

Modern Age

Stone Age

Bronze Age
Copper Age

Steel Age
Iron Age

Polymer
Age

Composites
Age

Silicon
Age

Sub-Micron Materials
Age

10000 BC 5000 BC 0 1000 1500 1800 1900 1940 1960 1980 1990 2000 2010 2020

Natural Ceramics

Metals

Alloys

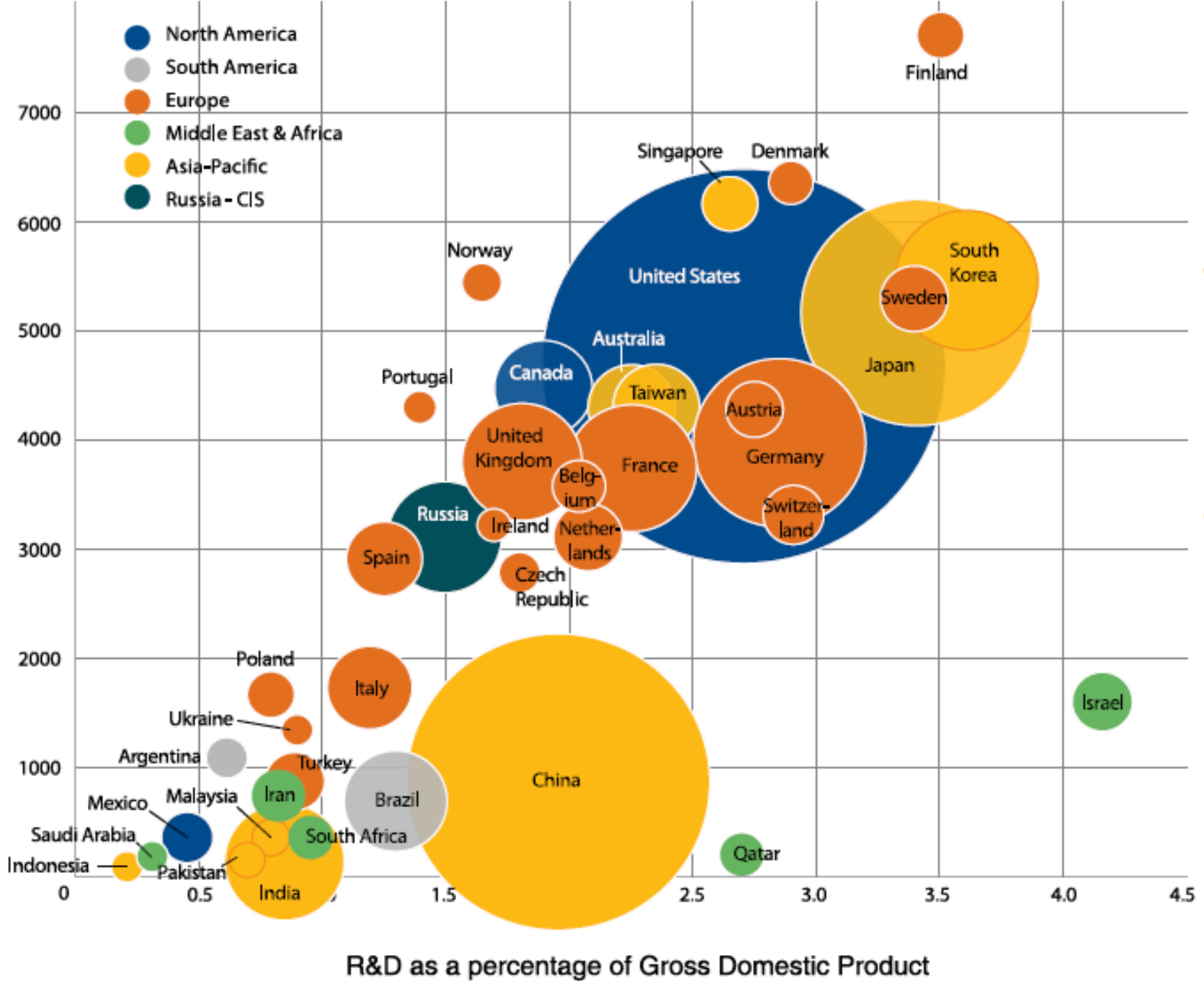
Molecules

Nuclear & Aerospace
Materials

Micro, Nano Engineered Materials



Scientists and Engineers per Million People



Source: Battelle, R&D Magazine, International Monetary Fund, World Bank, CIA Fact Book, OECD

International visiting scholars

International visiting scholars who temporarily visit host countries and then return to their home countries are considered one form of short-term **brain circulation**. Unlike brain drain or brain gain, brain circulation emphasizes the potential benefits for both the sending and receiving countries as a consequence of the continuous and circular moves

<http://www.uecare.org/ue/>

OF SCHOLARS.

<http://www.universityworldnews.com/article.php?story=20140924081517506>

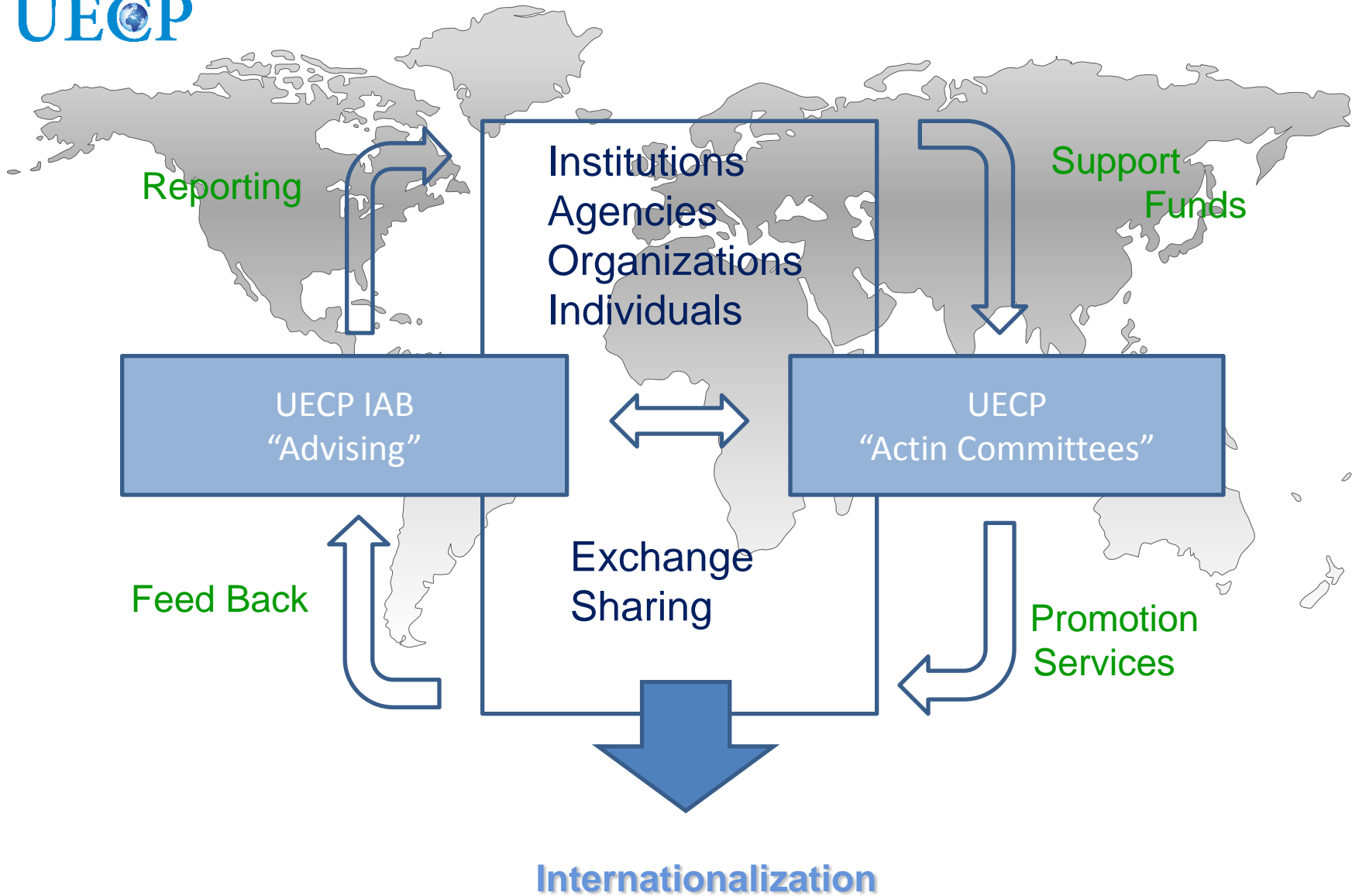


University Excellence Care Project



UECP

<http://www.uecare.org/ue/>



What are the numbers?

~ 200 million plus students in ~ 20,000 plus universities around the world

~ 5m to 10m students in the graduate programs (masters and PhD)

~ Hundreds of disciplinary areas and specializations

~ half a million students internationally mobile for higher education

T-Engineers (are specialized yet with broad based education. It is about a mix of knowing, doing and being)

Enhancers

Entrepreneurial, Intrapreneurial, & data analysis Skills

via Project management; Business; Finance; Leadership

Innovative & Creative Skills

via Research/Interdisciplinary/Multidisciplinary projects

Lifelong learning, proactive & adaptability skills

via Independent leaning; Society perspectives & challenges

Global Knowledge & Orientation (open mindset)

via Global learning; work in a diverse team; team work

Engineering Knowledge and Analytical Skills via Engineering Science, and Engineering Courses (depth)

Systems thinking, problem solving and design skills by applying engineering knowledge via Open Ended Design Projects/ Industry Internships

Professional Standards/Ethics & Social Conscience and Critical Thinking Skills via Breadth Courses; Self-awareness

ICT & Communication Skills via Technology Enhanced Learning/ Discussions/Presentations

Essentials

Why students enroll into graduate programs?

- ❑ To gain advanced skills and knowledge
- ❑ To move into new areas (compared to the bachelor degrees)
- ❑ To seek opportunities beyond the borders

Why graduate education is important?

- ❑ Universities need well qualified academics
- ❑ Industry and businesses need specialists and experts
- ❑ Research, invention and innovation need specialists in addition to the generalists

What complicates?

- ❑ Diverse program structures (course requirements, thesis requirements, publications, etc.)
- ❑ Incoming students with different levels of education attainments
- ❑ Variety of quality assurance and standards
- ❑ Work environment for the graduates is different from the yester years

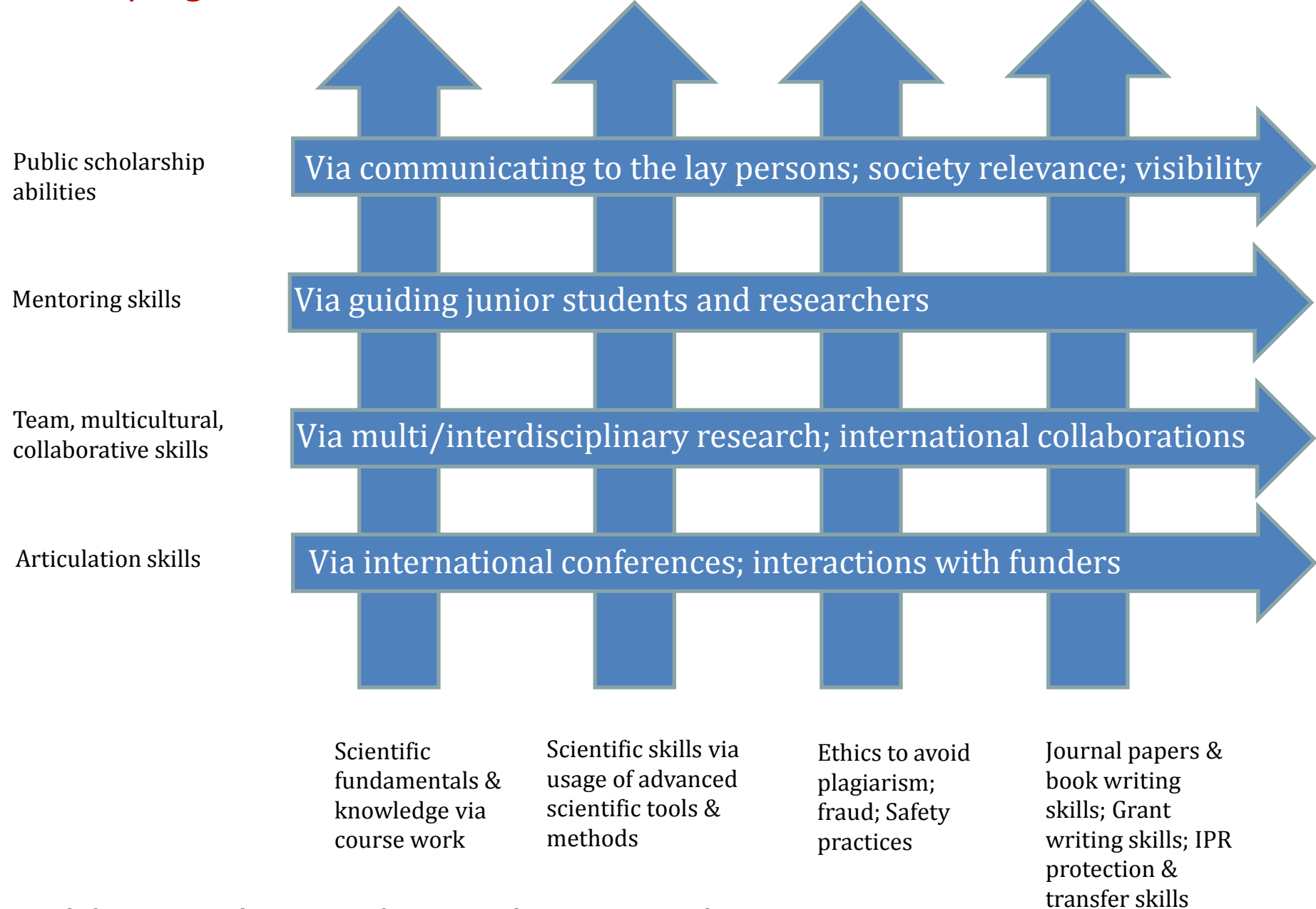
3 Is & E of Graduate Education

- Interdisciplinary approach
- Impact
- International collaboration
- Enterprising mindset

Graduate education of yester years

- Mono-disciplinary
- Depth focused
- Localized

Work environment for the graduates is different from the yester years: Developing Graduates and Researchers



CAMPUS AS LABORATORY

Innovative ways of teaching, learning and doing research are helping universities around the globe to adapt to the modern world

